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MADROÑO

A WEST AMERICAN JOURNAL OF BOTANY

VOLUME 14, NUMBER 2 APRIL, 1957

Contents

PAGE

NOTES ON PACIFIC MARINE ALGAE, *Paul C. Silva* 41

A NEW YUCCA FROM SONORA, MEXICO, *Howard Scott Gentry* 51

A REVISION OF THE LUPINUS ARBUSTUS COMPLEX OF THE LAXIFLORI, *David B. Dunn* 54

SOME ADDITIONS TO THE CALIFORNIA MOSS FLORA, *Howard Crum* 74

REVIEW: T. H. Goodspeed, *The Genus Nicotiana* (Richard W. Holm) 79

UBLISHED QUARTERLY BY THE CALIFORNIA BOTANICAL SOCIETY

MADROÑO

A WEST AMERICAN JOURNAL OF BOTANY

Entered as second-class matter at the post office at Berkeley, California, January 29, 1954, under the Act of Congress of March 3, 1879. Established 1916. Subscription price $4.00 per year. Published quarterly and issued from the office of Madroño, Herbarium, Life Sciences Building, University of California, Berkeley 4, California.

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NOTES ON PACIFIC MARINE ALGAE[1]

PAUL C. SILVA

For the past ten years I have been engaged in taxonomic and phytogeographic studies of the marine algae of the Pacific coast of North America. Although it is planned to present the results ultimately as a floristic treatise, the completion of this project is so far from sight as to suggest the usefulness of publishing certain nomenclatural, taxonomic, and distributional notes at this time. All specimens cited in this paper are in the Herbarium of the University of California, Berkeley. Collections are mine unless otherwise indicated.

Rosenvingiella nom. nov. *Gayella* Rosenvinge (1893, p. 936). Non *Gayella* Pierre (1890, p. 26). Lectotype: *G. polyrhiza* Rosenvinge.

Although unanimity of opinion regarding the validity of this genus of Prasiolaceae is lacking, many phycologists prefer to regard the terete members of this family as constituting a genus separate from *Prasiola.* Unfortunately, the name *Gayella* had been used previously (in the Sapotaceae) by Pierre. Therefore I have proposed the substitute name, *Rosenvingiella.* Two species have been reported from the Pacific coast of North America.

Rosenvingiella polyrhiza (Rosenvinge) comb. nov. *Gayella polyrhiza* Rosenvinge (1893, p. 937, figs. 45, 46).

Rosenvingiella constricta (Setchell et Gardner) comb. nov. *Gayella constricta* Setchell et Gardner in Gardner (1917, p. 384, pl. 33, figs. 5–9; pl. 32, fig. 5).

Rosenvingiella constricta and *Prasiola meridionalis* Setchell et Gardner (1920) occupy a unique ecological niche: they are restricted to rocks (usually offshore) covered with guano and pounded by heavy surf, upon which they form patches or distinct bands in the spray zone. *Rosenvingiella constricta* inhabits only the lower part of this association, where it may grow intermixed with *Prasiola meridionalis* or in nearly a pure stand. The green patches or bands may be seen from a considerable distance, but only occasionally is one able to get close enough to discern the two component growths, which differ slightly in color. Still more rarely is one able to collect from these rocks, so that the range of these associated species as indicated by documented records probably is smaller than the actual range. Heretofore these two species have not been recorded south of Carmel Bay. Although I have observed probable stands along the central California coast south of Carmel and on the Channel Islands, only once did circumstances permit collections to be made (Forneys Cove, Santa Cruz Island, 12 March 1950).

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[1] Grateful acknowledgment is made to the National Science Foundation and to the Research Board of the University of Illinois for grants in support of this study.

MADROÑO, Vol. 14, No. 2, pp. 41–80, May 1, 1957.

Ectocarpus dimorphus nom. nov. *Ectocarpus variabilis* (Saunders) G. M. Smith (1942, p. 647, figs. 1–4).

This distinctive species is commonly found growing on various Laminariales. Since *E. variabilis* G. M. Smith is a later homonym of *E. variabilis* Vickers (1905, p. 59) from Barbados, and since no other epithet is available, I have proposed a name which refers to the two kinds of plurilocular organs found in this species.

DICTYOPTERIS JOHNSTONEI Gardner (1940, p. 270, pl. 35). This species, which was published posthumously, is based on a "single, apparently fragmentary, part of a plant" dredged from 25 fathoms at Lone Cove, Santa Cruz Island, California (*G. R. Johnstone 96,* 28 November 1928, UC 472507). It is supposedly distinguished from *D. zonarioides* Farlow (1899) by the narrow segments and inconspicuous midrib. Hollenberg (1948) reported this species from "a large tide pool at medium high tide level on exposed rocky shore several miles south of Redondo Beach." Hollenberg's plant differs from the type, however, in being larger, coarser, and with well-developed percurrent axes. Material agreeing with the type was dredged by an Allan Hancock Foundation Expedition (Station 1431-41, 26 September 1941) off White Cove, Santa Catalina Island (Dawson, 1949, p. 21). Abundant material of *Dictyopteris* was dredged from 40 meters at the same locality by the M/V *Orca* of the J. W. Sefton Foundation Expeditions (*4231,* 8 February 1949), providing a series of specimens that strongly suggests the conspecificity of *D. johnstonei* and *D. zonarioides.* Although many specimens are typical *D. zonarioides,* others show a diversity of segment size, having some branches typical of *D. zonarioides,* other branches typical of *D. johnstonei,* and still other branches intermediate. Entire plants of the narrow *D. johnstonei* form were collected on the north shore of the west island, Islas San Benito, Baja California, Mexico (*6409,* 4 February 1950). The significance of this form remains to be demonstrated.

Laminaria setchellii nom. nov. *Hafgygia andersonii* Areschoug (1883, p. 3). *Laminaria andersonii* (Areschoug) Farlow ex Anderson (1891, p. 220). Non *L. andersonii* Eaton ex Hervey (1881, p. 98).

The name *Laminaria andersonii* has been applied to two species, and unfortunately the earlier application was to the species currently called *L. sinclairii* rather than to the plant which has been assumed to be *L. andersonii.* Doty (1947, p. 40) remarked that from Hervey's description of the blade "one would be inclined to think that he was referring to *L. Sinclairii.*" However, from Hervey's statements that the plant grew on rocks with *Pterygophora* and that it had "the usual branching hold-fast" Doty concluded that *L. andersonii* as usually interpreted was definitely indicated. Hervey described a specimen (which unfortunately I have not been able to locate) sent by Dr. C. L. Anderson from Santa Cruz, California, with a stipe one-sixth of an inch thick and about eighteen inches long bearing a blade about an inch wide and eighteen inches long. This description clearly refers to *L. sinclairii.* Indeed, on the label of specimen no. 118 of Farlow, Anderson and Eaton's Algae Exsiccatae Americae Borealis, "*Laminaria Andersonii* Eaton mscr in Rep't. U.S. Fish Comm. 1875," is listed as a synonym of *L. sinclairii.* Further clarification is provided by Farlow (1881): "Since it was ascertained that the species called *L. Andersonii* was the same as *Lessonia Sinclairii* the manuscript name of *L. Andersonii* has been applied by Prof. Eaton and myself to a second species from the California coast which belongs to the digitate division of the genus and not to the section *Saccharinae.*" Hervey apparently was not aware that the plant to which the manuscript name *L. andersonii* was originally applied has been recognized as *L. sinclairii,* and he thus unwittingly created a nomenclatural problem by effecting valid publication.

The epithet *andersonii* in its revised application was not validated until 1883, when Areschoug published it under *Hafgygia.* It was transferred to *Laminaria* by Anderson (1891), but the resulting combination is a later homonym and hence illegitimate. Inasmuch as no legitimate epithets are available for this species, I have proposed a new name in honor of W. A. Setchell, one of the foremost contributors to our knowledge of the Laminariales.

Heretofore the known range of this species has been Whidbey Island, Washington, to Carmel Highlands, Monterey County, California (Smith, 1944, p. 137). There are no herbarium specimens to authenticate the statement of Setchell and Gardner (1925, p. 605) that this species occurs as far north as Sitka, Alaska. The following collections extend the range northwest to Vancouver Island, British Columbia, and south to Santa Barbara County, California, and to certain of the Channel Islands.

CANADA. British Columbia. Vancouver Island: Point No Point, 16 miles west of Sooke, *7056.* UNITED STATES. California. Monterey County: mouth of Malpaso Creek, *3622;* Kasler Point, *814;* Point Sur, *1101;* Partington Point, *2256;* Lucia, *2844.* San Luis Obispo County: Point Piedras Blancas, *1359;* Cayucos, *2317.* Santa Barbara County: Point Sal, *5136;* Point Pedernales, *2402;* Point Arguello, *2541;* Point Conception, *2468.* San Miguel Island: Cuyler Harbor, *3743.* Santa Rosa Island: Sandy Point, *4128.* Santa Cruz Island: Fraser Point, *6050.* San Nicolas Island: first rocky outcropping west of sand spit, *4541.*

Laminaria setchellii is abundant in all surf-swept areas throughout the range on the mainland, forming extensive stands at lowest lower low water level (LLLW). On the Channel Islands it is an excellent indicator of localized cold water.

Laminaria sinclairii (Harvey ex Hooker f. et Harvey) Farlow, Anderson et Eaton (1878, no. 118). *Lessonia sinclairii* Harvey ex Hooker f. et Harvey in Hooker (1846, p. 460). *Hafgygia sinclairii* (Harvey ex Hooker f. et Harvey) Areschoug (1883, p. 6). *Laminaria andersonii* Eaton ex Farlow (1876, p. 715, *nomen nudum*). *Laminaria andersonii* Eaton ex Hervey (1881, p. 98). The original description of *Laminaria sinclairii* (as *Lessonia sinclairii*) is meager, but sufficient to validate the name. Failure to accept this description as valid publication would cause *L. ander-*

sonii Eaton ex Hervey to be the correct name for this species, thereby intensifying the nomenclatural confusion between *L. sinclairii* and *L. setchellii.*

Heretofore the known range of *Laminaria sinclairii* has been from Vancouver Island, British Columbia, to San Luis Obispo County, California. The following collections extend this range into Santa Barbara County, California: Point Sal, *5135;* Point Pedernales, *2403;* Point Conception, *2423*; Government Point, *5451, 5519, 5577*; Gaviota, *5275*. This species apparently is absent on the Channel Islands.

Dictyoneuropsis reticulata (Saunders) G. M. Smith (1942, p. 651, figs. 9–13). Two new localities can be recorded for this strikingly beautiful kelp, previously known only from sublittoral Monterey Bay. Three juvenile plants were collected by an abalone survey team of the California Department of Fish and Game from the Fort Ross cove area of Sonoma County at a depth of 3 to 12 meters, 20 September 1951. Extensive sublittoral stands were discovered off the Channel Islands by the Sefton Foundation Expeditions. One collection was dredged from 31 meters between Fraser Point and Kinton Point, Santa Cruz Island (*5884*) and another stand was found at a depth of 24 meters 1¼ miles southwest of Ford Point, Santa Rosa Island (*5981*), both in March, 1950. At Pacific Grove an occasional plant grows in the littoral zone at lowest lower low water level (*3044*). The blade of the largest plant dredged off Ford Point measured 19 by 107 cm., and this was clearly an incomplete specimen.

It is surprising how steadfastly Setchell refused to recognize the distinctness of this taxon, considering that he himself pointed out the differences between it and *Dictyoneurum* and even illustrated an unmistakable specimen (1896, p. 46, pl. 1).

Egregia J. E. Areschoug. Of the nine genera of Laminariales restricted to the west coast of North America, *Egregia* alone exhibits much variation. Heretofore, with collecting largely confined to the mainland of California north of Carmel and south of Santa Barbara, there have appeared to be two well-defined species: *E. menziesii* (Turner) Areschoug (1876), extending from Vancouver Island, British Columbia, to Point Conception in Santa Barbara County, California; and *E. laevigata* Setchell (1896), ranging from Point Conception to Baja California, Mexico, with isolated occurrences in Carmel, Monterey County, and Port Harford (Port San Luis), San Luis Obispo County. A study of a long series of specimens from the Channel Islands and the mainland between Carmel and Santa Barbara reveals a more complex picture: in these areas the two species overlap and intergrade, suggesting hybridization.

Typical *Egregia menziesii* has a tough rachis closely beset with simple, entire or dentate, spatulate blades. Short blunt tubercles cover all or most of the rachis (the lowermost portion may be smooth) and frequently also cover the bladders and blades. Typical *E. laevigata* has a smooth brittle rachis, somewhat broader than that of *E. menziesii*, bearing relatively large, elliptical to ligulate, simple and entire or frequently highly dissected blades. The foliar extension of the bladder, which in *E. menziesii* is stubby, is well developed and ultimately dissected. In the form with the blades dissected into filiform segments, this kelp is known as the "Feather Boa."

Despite the conspicuous differences between typical representatives of the two taxa, when a careful study is made of all available material as to the presence or absence of tubercles and the size, shape, degree of dissection and distribution of blades, the two species are seen to be far less sharply delimited than was previously believed.

Typical *Egregia menziesii* constitutes a remarkably uniform series of populations from Vancouver Island, British Columbia, to Government Point (just south of Point Conception), Santa Barbara County, California. At both ends of the range, however, deviation occurs. On Vancouver Island there is a population with highly dissected blades (Tofino, Clayoquot Sound, *Setchell & Parks,* 23 June 1930; Point No Point, 16 miles west of Sooke, *7053,* 17 June 1955). In the vicinity of Point Conception (from Point Pedernales to Government Point) there are plants (*2447*), putatively hybrid, that show certain characteristics of *E. laevigata* of that area, namely, a smooth rachis (except at the tips of branches) and a wider spacing of blades. No plants referable to *E. menziesii* occur on the mainland south of Government Point, but in the northern Channel Islands plants of *Egregia* consistently exhibit characteristics of the two species combined with intermediate features apparently at random. In the majority of specimens the rachis is tough (not brittle as in *E. laevigata*) and covered in part with tubercles that are longer and more slender than those of typical *E. menziesii.* The blades are variable in size and shape, but in older fronds they become highly dissected, as in *E. laevigata.* Although this series of populations seems to be of hybrid origin and is morphologically heterogeneous, its geographical distinctness supports its recognition as a subspecies. Assignment to one or the other species, however, seems to me to necessitate an arbitrary decision. Thus I arbitrarily refer the Channel Islands subspecies to *E. menziesii.*

EGREGIA MENZIESII (Turner) Areschoug subsp. **insularis** subsp. nov. Axis lentus haud fragilis plerumque partim attamen tuberculis gracilibus obtectus paginae frondium maturiorum profunde dissectae.

Rachis tough, not brittle, usually covered at least in part with slender tubercles; blades of older fronds highly dissected.

Type. North shore, West Anacapa Island, Ventura County, Channel Islands, California, 14 March 1950, *6130* (UC 981571).

Additional records. CALIFORNIA. Channel Islands: San Miguel Island: Cuyler Harbor, *3744.* Santa Rosa Island: Sandy Point, *4124;* mouth of Garañon Cañon, *4104*; Bechers Bay, *3235;* East Point, *3972.* Santa Cruz Island: Fraser Point, *Hubbs 47–81*; Willows Anchorage, *3809, 6047*; Smugglers Cove, *6207*; Prisoners Harbor, *4140, 5823;* Frys Harbor, *3352;* Twin Harbors, *3331.* Anacapa Islands: *F. H. Elmore.* Santa Barbara Island: landing, *4415;* southeast reef, *4354.* San Nicolas Island: first rocky outcropping west of sand spit, *4441.*

Egregia laevigata Setchell subsp. **borealis** (Setchell) stat. nov. *Egregia laevigata* forma *borealis* Setchell (Phyc. Bor. Amer. no. XL, 1901).

Typical *Egregia laevigata* occurs from Goleta, California, to Punta San Eugenio, Baja California, Mexico. Plants clearly referable to *E. laevigata,* yet differing slightly but consistently, are to be found in California from Gaviota, Santa Barbara County, northward to Santa Cruz, Santa Cruz County. The rachis is brittle and usually smooth, although at times the terminal blade, or the young rachis, or both, may bear short blunt tubercles. The blades are similar to those of *E. laevigata,* elliptical to ligulate, but are usually more widely spaced and never dissected. This series of populations as represented at Carmel was described by Setchell as *E. laevigata* f. *borealis.* However, its morphological uniformity and geographical distinctness would seem to warrant its recognition as a subspecies.

In an herbarium annotation, Setchell designated as the type of *Egregia laevigata* a specimen collected by him (*1659*) at Carmel Bay, Monterey County, California, 17 May 1897 (UC 96743). Inasmuch as this specimen was collected subsequent to the publication of *E. laevigata,* its selection as lectotype is untenable. In the original publication Setchell mentioned plants from Santa Cruz, Port Harford, and San Pedro, all California localities, but only those from San Pedro, Los Angeles County (*Setchell 1157,* December 1895) have dissected blades, a character emphasized by Setchell. Therefore, it seems reasonable to propose *Setchell 1157* as the lectotype collection, and, of several specimens available, UC 96758 as lectotype specimen.

Representative specimens examined. California. Santa Cruz County: Santa Cruz, *C. L. Anderson.* Monterey County: Monterey, *Setchell 1412 & 3080;* Pebble Beach, *1051, 1659, 1799, 3053.* San Luis Obispo County: Piedras Blancas, *1376, 5019;* Cambria, *H. L. Mason;* Cayucos, *2313;* Port Harford, *Setchell 1135;* Oilport, *Reed 57;* Pismo Beach, *5293.* Santa Barbara County: Point Arguello, *2517;* Government Point, *5454, 5520, 5575;* Gaviota, *5229.*

A case might well be argued for recognizing in *Egregia* only one species comprised of several subspecies. It seems of greater taxonomic usefulness, however, to continue the recognition of two species.

Bossiella nom. nov. *Bossea* Manza (1937a, p. 46).

This genus of Corallinaceae unfortunately bears a name that is a later homonym of *Bossea* in the Geraniaceae, which was proposed by Reichenbach (1841, p. 201) as a substitute name for *Cynosbata* (DC.) Rchb. and commemorates J. F. W. Bosse. The following species seem worthy of recognition.

Bossiella californica (Decaisne) comb. nov. *Amphiroa californica* Decaisne (1842, p. 124). As interpreted by Manza (1937b) and Smith (1944), this species is known only from the Monterey Peninsula, California. Yendo (1902b) reported it (as *Cheilosporum californicum*) from Vancouver Island, British Columbia, but the photograph of this collection indicates that most likely Yendo had a sparsely branched specimen of

B. corymbifera. The type must be restudied to eliminate the persistent uncertainty as to the identity of this taxon.

Bossiella cooperi (Dawson et Silva) comb. nov. *Bossea cooperi* Dawson et Silva in Dawson (1953, p. 158).

Bossiella corymbifera (Manza) comb. nov. *Bossea corymbifera* Manza (1937b, p. 562). Heretofore this species has been reported only from the Monterey Peninsula, California (Manza; Smith), and Coos County, Oregon (Doty). The following records amplify the known range.

CANADA. British Columbia. Vancouver Island: Point No Point, 16 miles west of Sooke, *7047*; Victoria, 1875, *R. Middleton.* UNITED STATES. Washington. Whidbey Island, *Gardner 918.* California. Mendocino County: Mendocino, *Brown 754a.* Sonoma County: 3 miles north of Fort Ross, *L. Miles;* Horseshoe Cove, near Bodega Bay, *L. Miles.* Marin County: Tomales Head, *W. Hartman.*

Bossiella dichotoma (Manza) comb. nov. *Bossea dichotoma* Manza (1937b, p. 562). This species, previously reported only as far north as Moss Beach, San Mateo County, California, has been found at Shelter Cove, Humboldt County *(7000).*

Bossiella gardneri (Manza) comb. nov. *Bossea gardneri* Manza (1937b, p. 563).

Bossiella insularis (Dawson et Silva) comb. nov. *Bossea insularis* Dawson et Silva in Dawson (1953, p. 159).

Bossiella interrupta (Manza) comb. nov. *Bossea interrupta* Manza (1937b, p. 563).

Bossiella ligulata (Dawson) comb. nov. *Bossea ligulata* Dawson (1953, p. 156).

Bossiella orbigniana (Decaisne) comb. nov. *Amphiroa orbigniana* Decaisne (1842, p. 124).

Bossiella pachyclada (Taylor) comb. nov. *Bossea pachyclada* Taylor (1945, p. 194).

Bossiella plumosa (Manza) comb. nov. *Bossea plumosa* Manza (1937a, p. 46). Heretofore this species has been reported only from San Mateo County (Manza) and the Monterey Peninsula (Smith) in California and from southern Oregon (Doty). The following records amplify the known range.

CANADA. British Columbia. Vancouver Island: Point No Point, 16 miles west of Sooke, *7048.* UNITED STATES. Washington. Jefferson County: Ruby Beach, *7104.* Oregon. Lincoln County: Yachats, *7135.* California. Del Norte County: Crescent City, *6902.* Humboldt County: Trinidad, *6827.* Mendocino County: mouth of Jughandle Creek, *6720.* Sonoma County: Shell Beach, 4 miles south of Jenner, *6671;* 2 miles north of Bodega Bay, *3496.* Marin County: Bolinas, *Gardner 1026.* San Francisco County: Lands End, *Setchell 5747.* Santa Cruz County: Santa Cruz, *3551.* Monterey County: mouth of Malpaso Creek, *3632;* Kasler Point, *820, 849;* Partington Point, *2288;* Lucia, *2817.* San Luis Obispo County: Cayucos, *2312.* Santa Barbara County: Point Pedernales, *2419*; Government Point, *5541.*

Bossiella sagittata (Dawson et Silva) comb. nov. *Bossea sagittata* Dawson et Silva in Dawson (1953, p. 157).

PACHYARTHRON CRETACEUM (Postels et Ruprecht) Manza (1937a, p. 45). This North Pacific species extends southward to Vancouver Island, judging from Yendo's photograph (1902b, pl. 51, fig. 1) of a plant collected at Port Renfrew (as *Amphiroa cretacea* f. *tasmanica*).

CALLIARTHRON REGENERANS Manza (1937b, p. 565). The following records outline the known range of this species, which heretofore has been reported only from San Mateo County in California (Manza) and Coos and Curry counties in Oregon (Doty).

CANADA. BRITISH COLUMBIA. Vancouver Island: Point No Point, 16 miles west of Sooke, *7045*. UNITED STATES. WASHINGTON. Whidbey Island, *Gardner 83*. CALIFORNIA. Del Norte County: Crescent City, *6904*. Humboldt County: Shelter Cove, *7002*. Mendocino County: mouth of Jughandle Creek, *6717*. Sonoma County: Shell Beach, 4 miles south of Jenner, *6670;* 2 miles north of Bodega Bay, *3495*. Marin County: Bolinas, *Gardner 1027*. Monterey County: Partington Point, *2278;* Lucia, *2837*. San Luis Obispo County: Piedras Blancas, *5040;* Pismo Beach, *5367*. Santa Barbara County: Government Point, *2195, 5467, 5511*. San Miguel Island: Cuyler Harbor, *3756*. Santa Rosa Island: Sandy Point, *4123*; Cañada Lobos, *2763*; East Point, *4071*. Santa Cruz Island: Fraser Point, *5967*; Willows Anchorage, *3823, 6039*; Smugglers Cove, *6221*. Santa Barbara Island: landing, *4405;* southeast reef, *4365*. MEXICO. BAJA CALIFORNIA. Islas Todos Santos: south island, *4829*.

CALLIARTHRON SCHMITTII Manza (1937b, p. 566). This rare species, heretofore known only from the San Diego region, has been found on littoral rocks at Eagle Point, San Juan Island, Washington (*Papenfuss & Scagel,* 7 July 1952). The fronds are prostrate, as inferred correctly by Manza from fragmentary dredged material.

Serraticardia (Yendo) stat. nov. *Cheilosporum* sect. *Serraticardia* Yendo (1905, p. 2). *Cheilosporum* subgen. *Serraticardia* Yendo (1902c, p. 193, *nomen nudum*). Type species: **Serraticardia maxima** (Yendo) comb. nov. *Cheilosporum maximum* Yendo (1902a, p. 22, pl. 2, figs. 18, 19; pl. 6, fig. 9).

Serraticardia macmillanii (Yendo) comb. nov. *Cheilosporum macmillanii* Yendo (1902b, p. 718, pl. 52, figs. 4, 5; pl. 56, figs. 11–14). *Calliarthron pinnulatum* Manza (1937b, p. 565).

This plant, heretofore known only from the original collection made by Yendo in the summer of 1901 at the Minnesota Seaside Station (Port Renfrew), Vancouver Island, has been discovered growing on surf-swept rocks of the lower littoral at two localities in California, namely, three miles north of Fort Ross, Sonoma County (*L. Miles,* 19 July 1951) and Pescadero Point, Monterey Peninsula (*3090,* 10 July 1948). The regular distichous opposite branching is suggestive of *Corallina,* but the conceptacles are borne laterally on the faces of intergenicula. On axial intergenicula the conceptacles are usually paired, one toward each lateral margin. Pinnae, being of approximately the same width as conceptacles, usually bear only one. According to Yendo, conceptacles may also occur terminally on pinnae, but my material does not show terminal conceptacles nor are Yendo's figures convincing. Conceptacles borne subterminally on the face of a pinna might easily be misinterpreted as terminal.

The most closely related species appears to be *Cheilosporum maximum* Yendo, from Japan, and both species were placed by Yendo in his section *Serraticardia* (Yendo, 1905, p. 26). Although Manza apparently was not familiar with *Cheilosporum macmillanii,* he (1937b, p. 567) referred *C. maximum* to *Joculator* Manza (1937a, p. 47), a genus based on the character that conceptacles may be both lateral and terminal in the same plant. (*Cheilosporum* as circumscribed by Manza is characterized as having conceptacles only on the upper margins of intergenicula.) *Joculator* was merged into *Corallina* by Dawson (1953, p. 124) on the consideration that lateral conceptacles sometimes occur in *Corallina officinalis* L. *Joculator pinnatifolius* Manza, the type of its genus, has a predominance of terminal conceptacles, and in this character as well as in general habit it seems more closely related to *Corallina* than to either *Cheilosporum macmillanii* or *C. maximum.* In the two latter species lateral conceptacles are the rule rather than the exception, and in habit they seem intermediate between a *Corallina* with compressed intergenicula (e.g., *C. chilensis* Decaisne) and a pinnate *Bossiella* (e.g., *B. plumosa*). In fact, it appears that we are dealing with a group of species which tend to bridge the gap between *Corallina* and *Bossiella,* two genera previously thought to be widely separated. No anatomical differences between these two genera have been demonstrated.

The occurrence of species intermediate between two genera need not affect the taxonomic usefulness and validity of recognizing both genera. In the present case *Cheilosporum macmillanii* and *C. maximum* seem sufficiently similar to one another and sufficiently different from both *Corallina* and *Bossiella* to warrant the recognition of a third genus.

The intergenicula of *Serraticardia* differ from those of *Bossiella* in not being expanded to the point of differentiating wings from the midrib. On the other hand, they are expanded more than those of *Corallina,* resulting in a more closely knit pattern of branching.

The type of *Calliarthron pinnulatum* Manza is a robust but poorly branched specimen of *Serraticardia macmillanii* from Moss Beach, San Mateo County, California (*Manza,* 2 January 1935). It is surprising that Manza referred this specimen to *Calliarthron,* a genus characterized by a unique anatomy of interwoven filaments.

PLOCAMIUM OREGONUM Doty (1947, p. 177, pl. 14, fig. B). According to entries in his notebook, N. L. Gardner had prepared a manuscript for this species and had designated as the type a collection from Trinidad, Humboldt County, California (June 1934, *Gardner 7837,* UC 536732). The following records supplement those cited by Doty (from Curry, Coos, and Lincoln counties in Oregon and Marin and Humboldt counties in California).

CANADA. BRITISH COLUMBIA. Vancouver Island: Point No Point, 16 miles west of Sooke, *7036.* UNITED STATES. CALIFORNIA. Mendocino County: mouth of

Jughandle Creek, *6706*. Sonoma County: Shell Beach, 4 miles south of Jenner, *6659*; 2 miles north of Bodega Bay, *3510*.

Department of Botany,
University of Illinois,
Urbana, Illinois

LITERATURE CITED

ANDERSON, C. L. 1891. List of California marine algae, with notes. Zoe 2: 217–225.

ARESCHOUG, J. E. 1876. De tribus Laminarieis et de Stephanocystide osmundacea (Turn.) Trevis. observationes praecursorias. Bot. Not. 1876: 65–73.

————. 1883. Observationes phycologicae. Particula quarta. Acta Reg. Soc. Sc. Upsal. ser. III, 12. 23 pp.

DAWSON, E. Y. 1949. Contributions toward a marine flora of the southern California Channel Islands, I–III. Allan Hancock Found. Publ. Occas. Paper no. 8. 57 pp., incl. 15 pls.

————. 1953. Marine red algae of Pacific Mexico. Part I. Bangiales to Corallinaceae subf. Corallinoideae. Allan Hancock Pacific Exped. 17(1):1–239, incl. 33 pls.

DECAISNE, J. 1842. Mémoire sur les Corallines ou Polypiers calcifères. Ann. Sci. Nat. Bot. ser. II, 18: 96–128.

DOTY, M. S. 1947. The marine algae of Oregon. Part I. Chlorophyta and Phaeophyta. Farlowia 3: 1–65, incl. pls. 1–10. II. Rhodophyta. *Ibid.* 159–215, incl. pls. 11–14.

FARLOW, W. G. 1876. List of the marine algae of the United States. Rept. U. S. Fish Comm. 1875: 691–718.

————. 1881. Note on Laminariae. Bull. Torrey Club 8: 67–68.

————. 1899. Three undescribed Californian algae. Erythea 7: 73–76.

FARLOW, W. G., C. L. ANDERSON, and D. C. EATON. 1878. Algae Exsiccatae Americae Borealis. Fasc. 3.

GARDNER, N. L. 1917. New Pacific coast marine algae. I. Univ. Calif. Publ. Bot. 6: 377–416, incl. pls. 31–35.

————. 1940. New species of Melanophyceae from the Pacific coast of North America. Univ. Calif. Publ. Bot. 19: 267–286, 6 pls.

HERVEY, A. B. 1881. Sea Mosses. Boston: Cassino. xv, 281 pp., 20 pls.

HOLLENBERG, G. J. 1948. Notes on Pacific coast marine algae. Madroño 9: 155–162.

HOOKER, J. D. 1846. Flora Antarctica. Part 21. Pp. 445–468.

MANZA, A. V. 1937a. The genera of the articulated corallines. Proc. Nat. Acad. 23: 44–48.

————. 1937b. Some North Pacific species of articulated corallines. Proc. Nat. Acad. 23: 561–567.

PIERRE, J. B. L. 1890. Notes botaniques. Sapotacées. [Part 1]. Paris: Klincksieck. pp. 1–36.

REICHENBACH, H. G. L. 1841. Repertorium herbarii sive nomenclator generum plantarum systematicus . . . Dresden & Leipzig: Arnold. xcv, 213, 236 pp.

ROSENVINGE, L. K. 1893. Grønlands Havalger. Meddelelser om Grønland 3: 765–981, 2 pls.

SETCHELL, W. A. 1896. Notes on kelps. Erythea 4: 41–48, 1 pl.

SETCHELL, W. A. and N. L. GARDNER. 1920. Phycological contributions I. Univ. Calif. Publ. Bot. 7: 279–324, incl. pls. 21–31.

————. 1925. The marine algae of the Pacific coast of North America. Part III. Melanophyceae. Univ. Calif. Publ. Bot. 8: 383–898, incl. pls. 34–107.

SMITH, G. M. 1942. Notes on some brown algae from the Monterey Peninsula, California. Am. Jour. Bot. 29: 645–653, 13 figs.

————. 1944. Marine algae of the Monterey Peninsula, California. Stanford University Press. ix, 622 pp., incl. 98 pls.

TAYLOR, W. R. 1945. Pacific marine algae of the Allan Hancock Pacific expeditions to the Galapagos Islands. Allan Hancock Pacific Exped. 12: i–iv, 1–528, incl. 100 pls., 3 text-figs.

VICKERS, A. 1905. Liste des algues marines de la Barbade. Ann. Sci. Nat. Bot. ser. IX, 1: 45–66.

YENDO, K. 1902a. Corallinae verae Japonicae. Jour. Coll. Sc. Tokyo Univ. 16 (article 3). 36 pp., 7 pls.

————. 1902b. Corallinae verae of Port Renfrew. Minn. Bot. Stud. 2: 711–722, pls. 51–56.

————. 1902c. Enumeration of corallinaceous algae hitherto known from Japan. Bot. Mag. Tokyo 16: 185–196.

————. 1905. A revised list of Corallinae. Jour. Coll. Sc. Tokyo Univ. 20 (article 12). 46 pp.

A NEW YUCCA FROM SONORA, MEXICO

HOWARD SCOTT GENTRY

Yucca grandiflora sp. nov. Arbor 3–4 m. alta; folia 70–100 cm. longa, 4–5 cm. medio lata, viridia, laevia, margine brunneo sparse-filifero, spina terminali valida basi sulcata, 2–2.5 cm. longa; inflorescentia paniculata, ramis lateralibus dense pubescentibus; perianthium subglobosum, segmentis subaequalibus, 7–9 cm. longis, ovatis, mucronatis, glabris; filamenta pubescentia, basi segmentorum adnata; ovarium elongatum, 4.5–6 cm. longum; stylus breviter 3-lobatus; fructum non vidi.

Arborescent, 3–4 m. tall, branching from the base and toward the crown, with deep leaf crowns; leaves 70–100 cm. long, 4–5 cm. wide at mid-blade, slightly narrowed above base, dark green, smooth, ascending to descending, persisting dry and deflected in age on the trunk, the margin narrow, brown, filiferate with long, fine, brittle threads, the terminal spine stout, brown, broadly grooved; inflorescence an irregular open panicle 70–100 cm. long; peduncle 10–30 cm. long, glabrate below; bracts and bractlets scarious, dull white, friable; lateral branches densely white-tomentose, flexuous, horizontal; flowers short-pedicellate to subsessile, glabrous, creamy white, divergent on horizontal, openly-spaced lateral branches (fig. 2); perianth 7–9 cm. long, the segments spreading, ovate, thin, bluntly mucronate, connate at base, the outer slightly smaller and thicker than the inner; filaments hyaline-pubescent throughout, the anthers oblong; pistil slender, 4.5–6 cm. long, deeply sutured, shortly beaked below the lobate stigma; fruits not seen.

Type. Above Tierra Negra, Cedros Range, east of Río Cedros, Sonora, Mexico, February 14, 1952, *Gentry 11601* (U. S. Nat. Herb. 2089433 and 2089434).

This plant differs from all other known species of *Yucca* in the large subsessile flowers borne on tomentose lateral branches in an open ragged-appearing panicle. Although the fruits are not available for study, the obvious relationship is with the group having fleshy fruits, the *Sarcocarpa.*

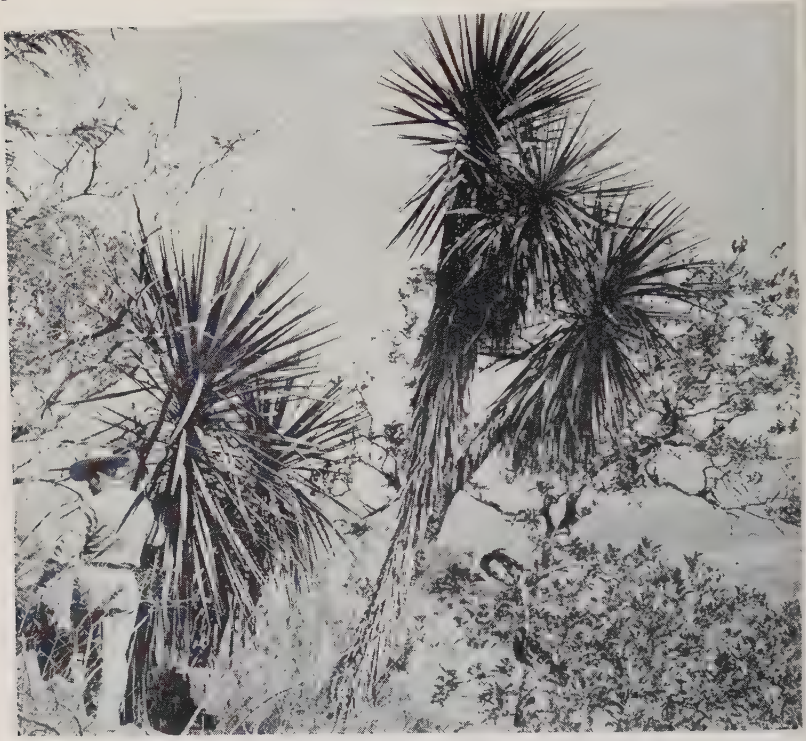

FIG. 1. Mature clump of *Yucca grandiflora* showing both basal and crownal branching. Above Tierra Negra on the Cedros Range in southern Sonora.

In the rather flexible, long, wide leaves and the pubescent lateral branches of the inflorescence, it resembles *Yucca schottii*. The large flowers and elongate pistils or ovaries, however, relate it more closely to *Y. arizonica*, from which it differs by the 1) pubescent lateral branches of the inflorescence as compared to glabrous branches, 2) subsessile flowers as compared to long-pedicellate flowers, 3) thin, finely veined, ovate perianth segments as compared to thicker, coarsely veined, lanceolate perianth segments, and 4) erect or divergent flowers as compared to nodding flowers.

In the type locality, where it formed a widely scattered colony, *Y. grandiflora* was found associated with species of *Quercus* and *Acacia pennatula* in an extensive tract of Oak Woodland having volcanically derived calcareous soils with a grass cover. Elevations here ranged from about 2500 to 3500 feet. A similar-appearing *Yucca* observed to the southeast of this locality, both along the Arroyo Guajaráy and the Río Mayo in adjacent Chihuahua, may prove eventually to be this species. It is known locally by its Warihio Indian name, "sahuiliqui."

This *Yucca* is one of many collected to determine sapogenin content. The leaves proved to contain 1.4 per cent sarsasapogenin, as reported by

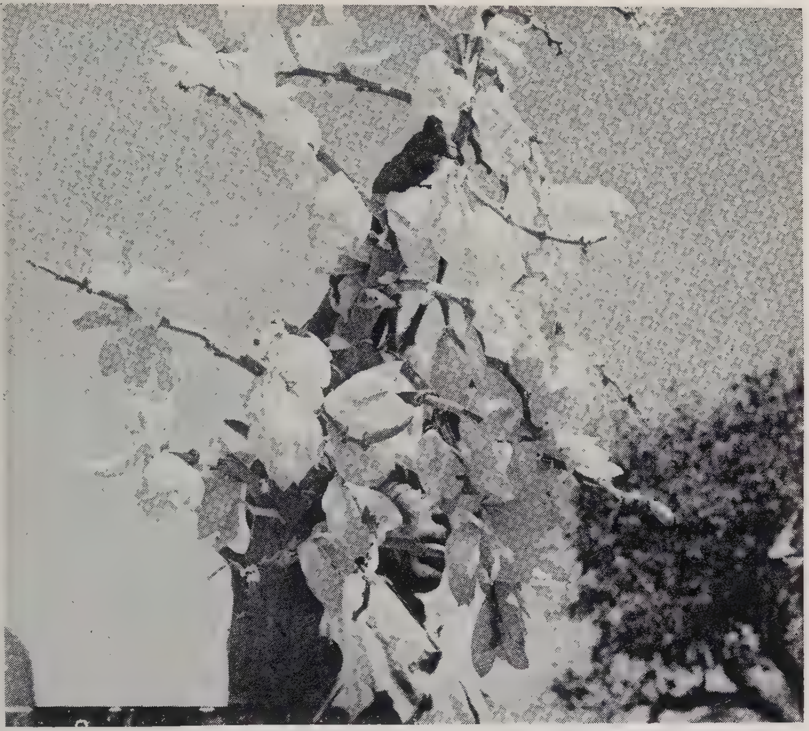

FIG. 2. Type material of *Yucca grandiflora* before pressing. Note the divergent subsessile flowers and the horizontal, openly spaced, lateral branches.

the Eastern Regional Research Laboratory at Philadelphia.[1] Sarsasapogenin is one of the steroidal compounds regarded as precursor to cortisone and related drugs. The fairly high percentage value of sarsasapogenin, together with the fiber in the numerous leaves, indicates an economic potential for *Yucca grandiflora*.

Plant Introduction Section, Horticultural Crops Research Branch,
Agricultural Research Service, United States Department of Agriculture, Plant Industry Station, Beltsville, Maryland

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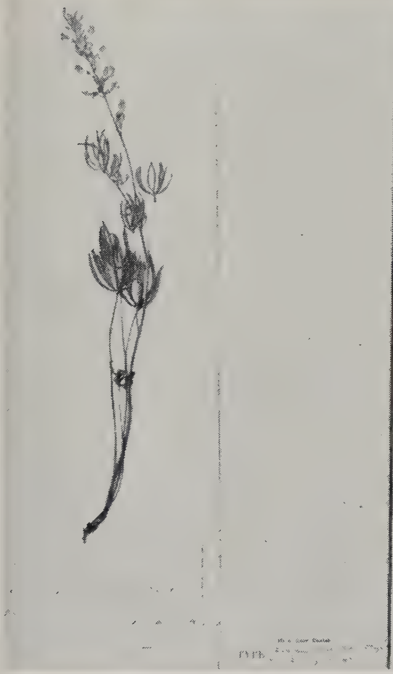
[1] Wall et al. 1955. Steroidal Sapogenins XXVI. Supplementary table of data for steroidal sapogenins XXV. U. S. Dept. Agr., Agr. Res. Serv. Circ. ARS–73–4.

A REVISION OF THE LUPINUS ARBUSTUS COMPLEX OF THE LAXIFLORI

DAVID B. DUNN

During and prior to the preparation of the manuscript of *Lupinus* for the Flora of Nevada (Dunn, 1956a), the type specimens of over 500 North American lupines, exclusive of species from Mexico, were examined. For each of these types, notes were taken, photographs were made, and floral parts were dissected and mounted in plastic, as described by Dunn (1954). One of the most important groups of type specimens examined was the Lindley collection of Douglas type specimens, Cambridge University (Dunn, 1956b). As a result of the extensive survey of these type specimens, together with careful study of the collection data recorded by Douglas in his journal (1914), it was deemed necessary to make several nomenclatural changes. Some of these were published earlier by me (Dunn, 1955) so that the names would be available for use in the Flora of Nevada. The opportunity now presents itself for discussion of the problems centering around *L. arbustus* and closely related taxa, and for a full explanation of the recombinations pertinent to this complex.

In studying the Douglas type material from the Lindley Herbarium (Dunn, 1956b), I came to the conclusion that Lindley's original description and illustration of *L. laxiflorus* (Bot. Reg. t. 1140, 1828) did not match the specimen labeled *L. laxiflorus* (*Douglas 297*, fig. 1). Instead, his description and illustration match the specimen labeled *L. tenellus* (*Douglas 277*, fig. 2). It is only possible to conjecture upon how this error came about. Whether the mixing of the two names occurred as an error by Douglas in collecting ripe seed at a later date than his herbarium sample or as an error when the seeds were planted, it is now impossible to say. In my opinion, however, the description and illustration are critical and must go with the specimen they fit rather than with the specimen which bears the cogent name, particularly for early material collected prior to the adoption of the type concept. (See Appendix 1, paragraph 4a, and Articles 19, 21; International Code, 1952). This interpretation, however, has resulted in the necessity for retypifying *L. laxiflorus*, and for bringing this name (*L. laxiflorus* Dougl. ex Lindl., not Agardh) into synonymy under *L. argenteus* Pursh. subsp. *argenteus* var. *tenellus* (Dougl. ex G. Don) Dunn, since the taxon involved is considered as below specific rank. The reason for the use of the varietal name *tenellus* is simply priority within a given rank (Articles 16, 66, 67, and 70; International Code, 1952). Fortunately *L. argenteus* was published by Pursh in 1814 so the name *L. argenteus* was not upset by recognizing that *L. laxiflorus* was a part of that species. Torrey and Gray were the first to apply a name below the rank of species to the taxon *tenellus* (see number 1 in taxonomic treatment). The "γ" used by Torrey and Gray as a prefix to the trinomial



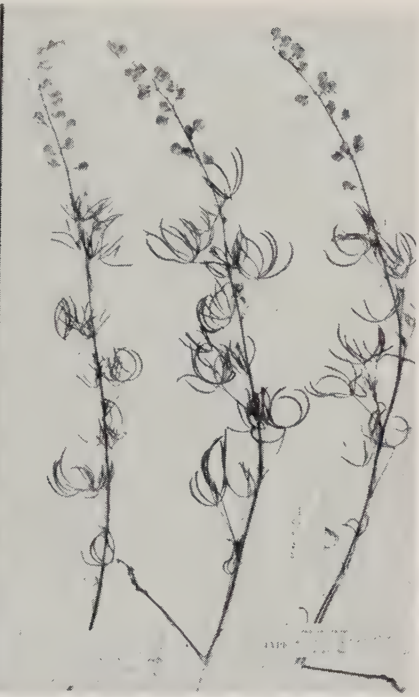


FIG. 1 (left). Photograph of the specimen in the Lindley Herbarium bearing the label *L. laxiflorus*. I have designated this specimen as the type of *L. arbustus* subsp. *neolaxiflorus* Dunn. It does not match Lindley's illustration or description in several important characters (see text).

FIG. 2 (right). Photograph of the specimen in the Lindley Herbarium bearing the label *L. tenellus*. This specimen matches Lindley's description and illustration of *L. laxiflorus* quite closely, with minor deviations (see text). This taxon is treated as *L. argenteus* subsp. *argenteus* var. *tenellus* (Doug. in G. Don) Dunn.

name *tenellus* has generally been conceded to mean a variety since it was not the practice of the time to designate subspecies.

This retypification of *L. laxiflorus* necessitates the redesignation of the taxon classically known as *L. laxiflorus* to subsp. *neolaxiflorus* (Dunn, 1955) and placing it under *L. arbustus* Dougl. ex Lindl. (Bot. Reg. t. 1230, 1829) which is the next specific epithet in line, thus retaining as much continuity of the name as possible. The name *laxiflorus,* then, is no longer spread over five other subspecific taxa, but is restricted to subsp. *neolaxiflorus* specifically, the taxon to which Agardh and botanists since then have been applying the name *laxiflorus* in the strict sense and not in the broad sense employed in current manuals.

The characters of most fundamental importance in interpreting the specimen labeled *L. tenellus* to be the taxon described by Lindley as *L. laxiflorus* are: 1) the short petioles throughout, about as long as the leaf-

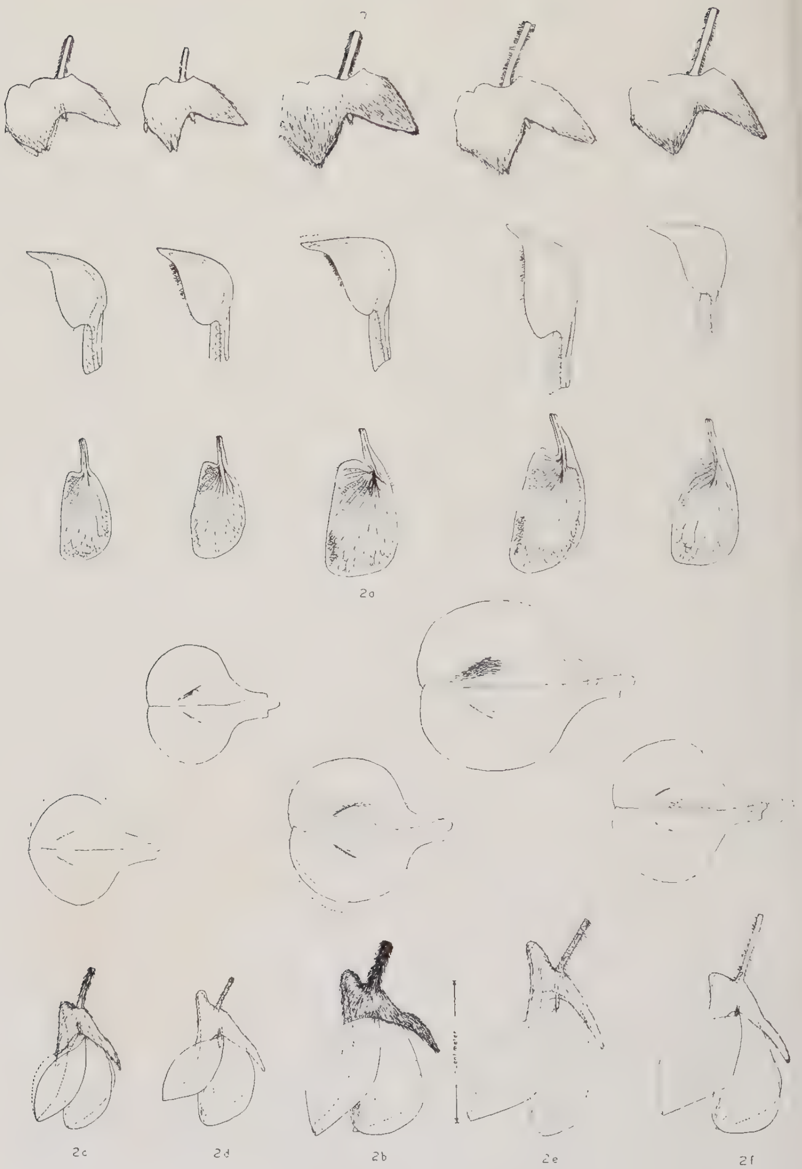


FIG. 3. Chart of the floral parts of the taxa within *Lupinus arbustus,* solid lines drawn to the typical shape and uniform scale of the mean measurements of 25 individuals (numbers 2*b*, etc., refer to taxa in text and on Map 1). Dotted lines represent parts beneath the surface, folds under the outer surface or, as in the banner and wings, the range of shape. The horizontal rows from bottom to top represent 1) left side view of entire flower; 2) flattened dorsal view of the banner, the two halves showing the range in the amount of pubescence; 3) left wing; 4) right side view of keel;

lets (fig. 2) and illustrated by the artist in Edwards' Botanical Register (t. 1140, 1828); 2) the leaves appearing fasciculate due to the short petioles and to the occurrence of several leaves on the dwarf axillary branches present at most of the nodes at anthesis of the primary racemes; 3) leaflets linear to linear-elliptic-oblanceolate as illustrated; 4) the slender purplish stems referred to by Lindley; the specimen labeled *tenellus* is distinctly purplish and slender by contrast with the specimen labeled *laxiflorus*; 5) the obcordate shape of the banner described and illustrated; and 6) the floral parts (plastic-coated dissections) match the illustration, t. 1140.

Lindley's statements referring to an absence of bracteoles (in his description of *L. laxiflorus*) and a beardless keel are both erroneous since both of the specimens labeled *L. tenellus* and *L. laxiflorus* have bracteoles and ciliate keels, although the former has the least ciliation. Both also have a spur about 0.5 mm. long at the base of the upper lip of the calyx.

The shape and conformation of the floral parts (fig. 3c, solid lines) were drawn from *Douglas 297* (fig. 1), which is considered typical for *L. arbustus* subsp. *neolaxiflorus*. The extent to which the flowers differ from the illustration in Edwards' Botanical Register (t. 1140) should be apparent.

It should be noted that more of the characters which indicate that the specimen labeled *L. tenellus* is the taxon described as *L. laxiflorus* are to be found in the illustration than are found in the description. I dare say this situation is not uncommon among taxa described in either Edwards' Botanical Register or in the Curtis' Botanical Magazine. That the purpose of an illustration is to clarify characters difficult to describe in words is recognized by the Recommendation 54F of Article 54, International Code (1952), where illustrations are recommended. I would contend that where such are provided with the original description that the illustrations are an integral part of the description. The extent to which illustrations are recognized by the Code is noted in Article 21 in which it is stated that an illustration or a description may become the type for a species without a type specimen. It should further be pointed out that the specimens in the Lindley Herbarium considered as types are more technically lectotypes. Thus, Article 19 is involved regardless of who wrote the name *L. laxiflorus* on the specimen (fig. 1). Note again the wording in the International Code (Appendix 1, paragraph 4a, Determination of types); wherein "recognizable figures" are specifically acknowledged as being a means of determining what material has been described.

My interpretation, previously published in outline (Dunn 1955, 1956b), has been questioned by Phillips (1955, p. 196), whose paper came out

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5) inside view of the unfolded calyx cup, slit from the left sinus to the pedicel. Since the floral parts for *2a* and *2b* are very similar in shape, only the wing is illustrated for *2a* (within the *2b* series); the wing of *2b* is glabrous both laterally and marginally near the claw (not illustrated). Subspecific entities are indicated by the key figures: *2a–2f*.

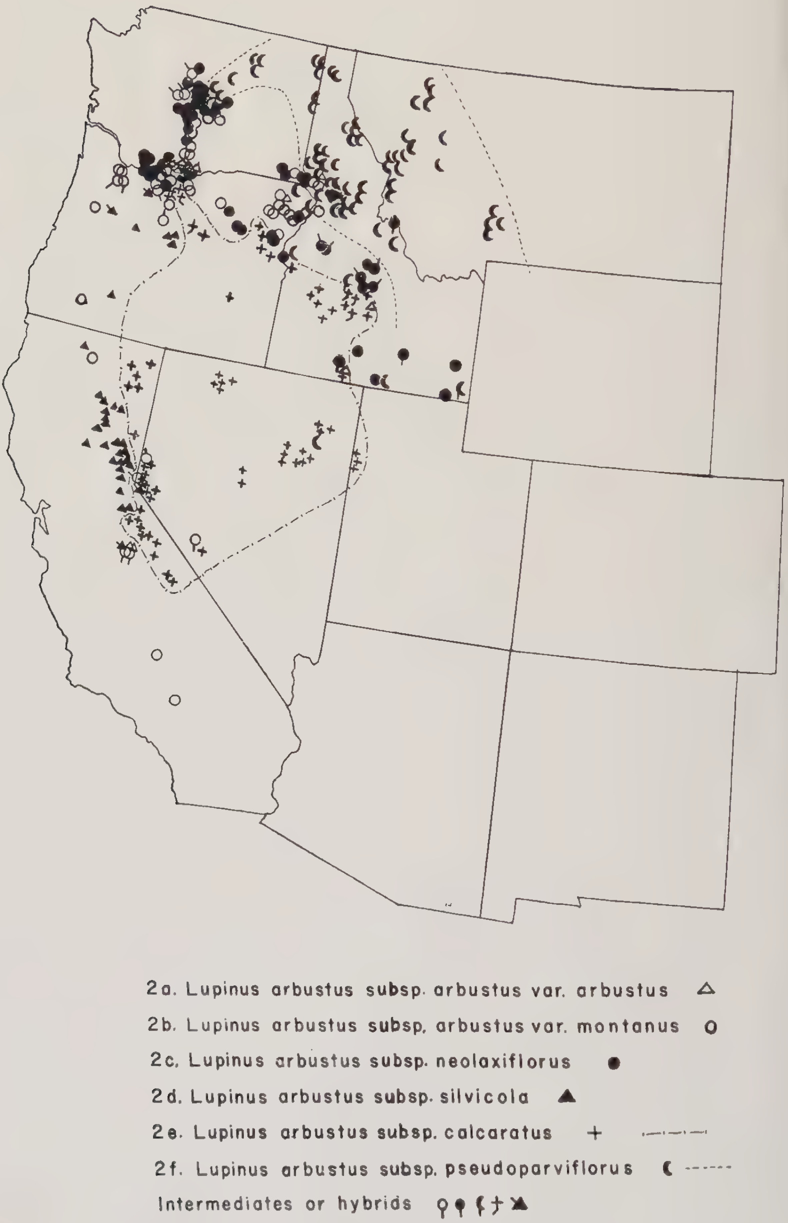
2a. Lupinus arbustus subsp. arbustus var. arbustus △
2b. Lupinus arbustus subsp. arbustus var. montanus O
2c. Lupinus arbustus subsp. neolaxiflorus ●
2d. Lupinus arbustus subsp. silvicola ▲
2e. Lupinus arbustus subsp. calcaratus + —·—·—
2f. Lupinus arbustus subsp. pseudoparviflorus (------
Intermediates or hybrids

FIG. 4. Distribution of the taxa within *Lupinus arbustus*.

after I had submitted this present manuscript for publication in June, 1955. Phillips admits that Lindley's description of *L. laxiflorus* does not fit the specimen labeled *L. laxiflorus,* but he believes the latter to be labeled in Lindley's handwriting, whereas I am convinced it is in Agardh's. Phillips borrowed only the types designated as *L. tenellus* and *L. laxiflorus*. Phillips fails, however, to recognize the significance of the coincidence of morphological characters in Lindley's description and illustration of *L. laxiflorus* with the characters shown in the specimen labeled *L. tenellus,* nor does he recognize the significance of the characters which differentiate the specimen labeled *L. tenellus* from the specimen labeled *L. laxiflorus*.

Phillips, in other words, relies on what has been presumed to be the type specimen irrespective of the facts that the authorship of the handwriting thereon is uncertain and that neither the type description nor the illustration fits this presumed type specimen. It should be emphasized that the type concept was not accepted in Europe until the 1930's, after which time type labels were placed on specimens by current workers; sometimes sheets with type material were cut apart and the parts mounted on separate sheets; and, in one case of which I know, the type label was transferred to the wrong half of the sheet. There has been too much chance for error in the processing and reprocessing of the early specimens. With this early material it is not the specimen considered as the type itself, but the description and illustration which are critical, as noted repeatedly in the International Code (1952, Articles 19, 21, and Appendix 1). In the case of the lupines under consideration, I have made a considerable effort, as already stated, to clarify these matters and to coordinate the type localities as given in Douglas' Journal (Dunn, 1956b) with the type specimens in the Lindley Herbarium and with their published descriptions.

The taxonomic problems involved with the treatment of lupines have been multiplied considerably since settlement of western North America. Extensive cattle grazing undoubtedly created numerous openings, and in more recent years the great increase of roads has greatly multiplied the disturbed areas. Lupines are early invaders in areas very low in soil nitrogen such as the exposed subsoils of road cuts or areas vacated by receding glaciers (Lawrence, verbal communication, 1950). Road cuts are commonly inhabited by lupines, a site inadequate for most plants lacking a means of nitrogen fixation. Several species, normally perennial but capable of maturing seed in one season, are now commonly found scattered through grainfields. Such extensions of suitable habitat have undoubtedly resulted in many range extensions during the past hundred years, thus bringing taxa into contact which may have appeared quite distinct in Douglas' time, but which had not been segregated sufficiently long to develop adequate barriers to hybridization. The study of the taxa of *Lupinus* encompassed in the Flora of Nevada has revealed that there are occasional morphological intermediates between many of the closely related taxa.

Many of these intermediates have been collected since settlers and mechanization have come to the country. While it is readily admitted that collecting conditions became simpler with the advent of roads, accounting for increased knowledge of the genus, another explanation must also be considered as possible, if not probable, for the occurrence of morphological intermediates. This is Edgar Anderson's theory of introgressive hybridization (1949), which appears to fit the situation well. His explanation of the survival of hybrid swarms gives a plausible reason for the existence of these intermediates, although it is questionable if they do more than survive long enough to permit some gene flow between what are otherwise well-established taxa with genomes that have been selected by the environment over a long period of time. The question arises as to how to deal taxonomically with these intermediates. If all the taxa which have intermediates between them were placed in one species, the genus *Lupinus* would be reduced to a handful of species, but the keys to separate the subspecific taxa would indeed be complex. I believe it is far better to treat many of the taxa as ecospecies in the sense advanced by Anderson.

At this point I wish to express my appreciation to the officials of the herbaria cited in the text below for the loan of the material and especially to Dr. P. A. Munz for the use of the facilities at the Rancho Santa Ana Botanic Garden where most of the work on this paper was done.

KEY TO THE TAXA

Petioles all short, 2–4 cm. long, the lower ones commonly not much longer than the leaflets, occasionally up to 8 cm. long; leaves cauline; banner obcordate to orbicular, sparsely pubescent in the dorsal grooves; the wings glabrous; calyx spur generally wanting, short but present in *L. argenteus* subsp. *argenteus* var. *tenellus*. (*Lupinus argenteus* and allies; not treated here except for the nomenclature of the var. *tenellus*)............................1. *L. argenteus* subsp. *argenteus* var. *tenellus*

Petioles gradated, the lower ones 8–15 cm. long, to 2–4 cm. long on the uppermost leaf; commonly mostly basal leaves but members of some taxa with the leaves all cauline, then with the longest lower petioles over 10 cm. long; banner obovate to orbicular; calyx spur generally well-developed, except in *L. sulphureus* and allies.

  Banner glabrous (a few individuals with some pubescence on the back); wings glabrous; the base of the calyx enlarged, gibbous above, not spurred. ....*L. sulphureus* and allies, not treated here.

  Banner generally abundantly pubescent over the central area of the back, sometimes only sparsely pubescent in the grooves or sometimes glabrous; wings generally with lateral pubescence near the tip but sometimes glabrous in members of two taxa; calyx spur generally well-developed.

    Leaflets glabrous above, or glabrate, oblanceolate, 6–10 mm. wide, banner and wings pubescent or often glabrous; in damp habitats; northeastern Washington and the Rocky Mountains......2f. *L. arbustus* subsp. *pseudoparviflorus*

    Leaflets pubescent above, sparsely so in some, generally linear-elliptic, to oblanceolate, banner and wings pubescent, or often glabrous in subsp. *neolaxiflorus*; California, Nevada, Oregon, Washington and the southern half of Idaho.

      Flowers 6.5–9.5 mm. long, excluding the spur.

Plants 2–4 dm. tall, stems clumped, generally with several long-petioled (8–12 cm.) basal leaves; wings and banner glabrous or pubescent; Wenatchee Mountains, Washington, south-eastward into the Snake River drainage of southern Idaho (specimens from the southeastern part of the range exhibit a reduction in the number of basal leaves and an increase in pubescence and height of plant).
....2c. *L. arbustus* subsp. *neolaxiflorus*

Plants 4–5 dm. tall, stems few, with few or no basal leaves, the leaves oblanceolate or narrowly so, sparsely pubescent above; wings pubescent at the tip; spur somewhat slender; banner orbicular, pubescent in the dorsal grooves; northern Sierra Nevada, California, and Cascade Mountains, Oregon.........................2d. *L. arbustus* subsp. *silvicola*

Flowers 9.0–14 mm. long, excluding the spur; banner and wings pubescent, the banner rarely glabrous.

Flowers 11–14 mm. long, generally white or light yellow to lavender (see also var. *montanus*), intermediates bright purplish blue; calyx spur slender, 1–3 mm. long; upper lip generally 6–7 mm. long; wings and flower slender, viewed laterally; Great Basin.
....2e. *L. arbustus* subsp. *calcaratus*

Flowers 9–12 mm. long; purplish blue to pinkish lavender, drying blue; calyx spur blunt and broader, 1–1.5 mm. long; upper lip 5 mm. long; wings 4–5 mm. wide; the flowers appearing wider; mountains of northeastern Oregon and southward into the southern Sierra Nevada, California.

Wings with pubescence laterally near the apex only.
....2b. *L. arbustus* subsp. *arbustus* var. *montanus*

Wings with pubescence as above but also with cilia above or below the claws or with lateral villi on the veins near the claws, or with hairs at all three locations......2a. *L. arbustus* subsp. *arbustus* var. *arbustus*

1. LUPINUS ARGENTEUS Pursh subsp. ARGENTEUS var. TENELLUS (Dougl. in G. Don) D. Dunn, Leafl. West. Bot. 7:254. 1955. (G. Don cites Dougl. mss. but the description is not a copy of anything in Douglas' Journal; some other mss?). Type. *Douglas 277,* 31 May 1825 (CGE), p. 125 in Douglas' Journal, collected from the vicinity of the Grand Rapids of the Columbia River, Washington or Oregon (±40 miles "?", Douglas' hiking range). *Lupinus laxiflorus* Dougl. ex Lindl. not Agardh, Bot. Reg. t. 1140. 1828. *Lupinus tenellus* Dougl. in G. Don, Gen. Hist. Dichl. Pl. 2:367. 1832. *Lupinus laxiflorus* var. ("γ") *tenellus* (Dougl. in G. Don) Torr. & Gray, Fl. N. Am. 1:377. 1840 (*L. foliosus* var. ("β") *stenophyllus* Nutt. mss. *ibid.* in syn.). *Lupinus stenophyllus* Nutt. ex Rydb. Bull. Torrey Club 34:42. 1907. *Lupinus argenteus* var. *stenophyllus* (Nutt. ex Rydb.) Davis, Flora Idaho, 492. 1952. *Lupinus lanatocarinatus* C. P. Smith, Sp. Lup. 317. 1942 (an intermediate with *L. caudatus* Kell.). Type. East of Fort Hall, Bingham County, Idaho, *Davis 137–35* (IDS). *Lupinus fremontensis* C. P. Smith, Sp. Lup. 320. 1942. Type. Sand dunes 6 miles northwest of St. Anthony, Fremont County, Idaho, *Davis 326* (DS, isotype at IDS). *Lupinus edward-palmeri* C. P. Smith, Sp. Lup. 572. 1946. Type. Big Butte Station, Idaho, *Palmer 558* (US). *Lupinus carciformes* C. P. Smith, Sp Lup. 574. 1946. Type. Four miles south of Macks Inn, Fremont County, Idaho, *Christ & Ward 14899* (DS, isotype at NY).

Lupinus hullianus C. P. Smith, Sp. Lup. 573. 1946. Type. From a burn, Clark County, Idaho, *Hull 235* (USFS 91141, co-type DS-Sm.).[1] *Lupinus montis-cookii* C. P. Smith, Sp. Lup. 726. 1952. Type. Cook Mountain, Clearwater Forest, Idaho, *Sutton 70* (USFS 38580).

A detailed description is not presented here, since it is considered that such properly belongs in a monographic treatment of the "argenti" which will be presented at a later date. The name *tenellus* has priority at the rank of variety. The name *stenophyllus* may require recognition at some rank below the level of species when the type specimen is located. It is not possible to separate the two as Rydberg did, since the type of *tenellus* has a distinct but short spur, which Rydberg used to characterize *stenophyllus*. Hence, the treatment of var. *stenophyllus* as a synonym of var. *tenellus* as given in Torrey and Gray's Flora of North America appears correct. The short spur, however, led Torrey and Gray to place the variety *tenellus* in the species *L. laxiflorus sensu* Agardh. The taxon *tenellus* (*L. laxiflorus* of Lindl.) belongs in the species *argenteus,* as pointed out by Davis (Fl. Idaho, 1952), because of the shape of the banner. There is also a light patch of ciliation on the back of the banner under the lip of the calyx, a character which occurs consistently throughout the *L. argenteus* complex (except in *L. rubricaulis*). The pubescence on the back of the banner in the *L. arbustus* group ranges from none to an extensive area on the back.

2a. *Lupinus arbustus* Dougl. ex Lindl. Bot. Reg. t. 1230. 1829 (subsp. *arbustus* var. *arbustus*). Lindley wrote " . . . local . . . gravely soils in North California, . . . common near Fort Vancouver . . " This statement is in error. Douglas went to California on December 22, 1830. The notes in Douglas' Journal (1914) matching this taxon place the type region near Falls of the Columbia (Celilo Falls, Klickitat County, Washington or Wasco County, Oregon), *Douglas 296,* 20 June 1825 (CGE). *Lupinus laxiflorus* var. *arbustus* (Dougl. in Lindl.) M. E. Jones, Contrib. West. Botany 14:33. 1912. *Lupinus laxiflorus* var. *laxiflorus sensu* Phillips *pro parte,* Res. St. State Col. Wash. 23:196. 1955.

Plants 3–6 dm. tall; dry stems 3–4 mm. in diameter, finely sericeous to densely subappressed-sericeous; lower petioles 8–13.5 cm. long, present at flowering or the leaflets fallen; leaflets of the largest leaves 8–12, 4–5.5 cm. long, 5–8 mm. wide, linear-oblanceolate, tending to be conduplicate, arcuate, the tips acute; peduncles 3–5 cm. long; flowers 10–12 mm. long; base of the upper calyx lip developed into a distinct spur 1–1.5 mm. long; banner reflexed above the midpoint, pubescent over the central area of the back and pubescent in the ventral sulcus near the umbos; wings with lateral pubescence near the tip and also with lateral villi on the veins near the claws and ciliation on the edges above and below the claws; keel densely ciliate near the acumen and sparsely so above the claws, also with lateral villi near the claws; ovules 4–5; mature pods not seen.

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[1] DS–Sm.=C. P. Smith Herbarium in the Dudley Herbarium, Stanford University. All other abbreviations of herbaria follow Lanjouw & Stafleu, Index Herbariorum 2. 1952.

The variety *arbustus* in its typical form appears to be of rare occurrence. Unfortunately the specific name was applied by Douglas to a plant (*Douglas 296*), which appears to be of hybrid origin or perhaps ancestral to, or at least lying between, *L. caudatus* Kell. and the rest of the complex treated here as *L. arbustus,* of which *L. arbustus* subsp. *neolaxiflorus* Dunn represents an extreme. The floral characters of the type specimen, *Douglas 296,* in the Lindley Herbarium combine traits of *L. caudatus* (which has lateral villi near the claws of the wings and keel and marginal cilia above and below the claws of both the wings and keel, the hairs occasionally absent at two or three of the six locations) with those of the various subspecies treated here under *L. arbustus* (which have a patch of pubescence laterally near the tip of the wings, commonly absent in a percentage of two subspecies). The vegetative affinity and nature of the pubescence of the plant are both very close to var. *montanus* which grades into subsp. *neolaxiflorus* in one direction and subsp. *calcaratus* in the other direction.

The specimens of more recent collection which match the specimen *Douglas 296* are from what appears to be a local endemic population in the mountains of Klickitat County, Washington. This suggests that Douglas collected both *296* and *297* in that area, but it is possible that a similar population may exist or have existed on the south side of the Columbia River in Wasco County, Oregon.

The taxon *L. caudatus* was observed to be sympatric with *L. arbustus* subsp. *calcaratus* (Kell.) Dunn, but there appears to be a barrier to hybridization since no intermediates were observed in herbarium material. Hence *L. caudatus* was retained in its present status, rather than reducing it to a subspecies of *L. arbustus. Lupinus caudatus* appears to hybridize with several of the other subspecific taxa within *L. arbustus,* however, and thus may form one end of an overlapping ring of subspecies as discussed by Goldschmidt (1952, p. 90). Since the present evidence suggests that *L. caudatus* may be an ecospecies, it was considered that breeding studies would be necessary before reaching a decision involving any change in status of *L. caudatus.* Judging from the number of morphologically intermediate herbarium specimens seen, *L. caudatus* also appears to hybridize with several other less closely related taxa than those mentioned above.

Some anomalies have resulted from what appears to have been hybridization between *L. caudatus* and *L. arbustus* subsp. *silvicola* and secondly, *L. caudatus* and *L. arbustus* subsp. *neolaxiflorus,* such anomalies resembling *L. arbustus* subsp. *arbustus* var. *arbustus,* but being well beyond the range of the typical material as well as showing vegetative affinities with the suggested parents. Five such specimens are: 1) *Congdon* (MIN), July 25, 1891, Independence Mountains of Cassia County, Idaho; 2) *Christ 14486* (NY), from the same place; 3) *Lyle* (DS), August, 1930, 7 miles south of Lick Ranger Station, North Fork, Wallowa River, Wallowa County, Oregon; 4) *Congdon* (MIN), near Inspiration Point, Yosemite, Mariposa County, California; 5) *Shoop 94* (UMO), Majic Dam, Hailey, Blaine County, Idaho.

Distribution. WASHINGTON. Klickitat County: vicinity of the Falls of the Columbia, *Douglas 296* (see type citation); hillsides at top of grade from Roosevelt to Bickelton (flowers deep wine-red), *Pickett, McMurray, & Dillon 1441* (WS); western Klickitat County (near Bingen?), *Suksdorf 39* (WS); Columbus, *Suksdorf 1792* (WS).

2b. LUPINUS ARBUSTUS subsp. ARBUSTUS var. MONTANUS (Howell) Dunn, Leafl. West. Bot. 7:254. 1955. *Lupinus laxiflorus* var. *montanus* Howell, Erythea 3:33. 1895. Type. Mount Hood, Oregon, *T. Howell 1494* (isotype, UC, MO). *Lupinus laxiflorus* var. *cognatus* C. P. Smith in Jepson, Man. Fl. Pl. Calif. 527. 1925. Type. Wallowa Mountains, Oregon, *Cusick 3187* (DS). *Lupinus lutescens* C. P. Smith, Sp. Lup. 235. 1940. Type. Badger Mountain, Douglas County, Washington, *Thompson 14626* (WTU). *Lupinus proteanus* Eastw. Leafl. West. Bot. 4:190. 1945. Type. Emigrant Pass, Nevada, *Eastwood & Howell 231* (CAS). *Lupinus perconfertus* C. P. Smith, Sp. Lup. 738. 1952. Type. Lemhi Nat. Forest, Horse Heaven Pass, Idaho, *Cusick 59* (USFS 56696). *Lupinus laxiflorus* var. *laxiflorus sensu* Phillips *pro parte*, Res. St. State Col. Wash. 23:197. 1955.

Plants 3–6 dm. tall; dry stems 2.5–3.5 mm. in diameter, clustered, from a woody caudex, sericeous; longest lower petioles 9–16 cm. long, present at anthesis; leaflets of largest leaves 9–13, 3–4.5 cm. long, 5–7 mm. wide, linear-elliptic to linear-oblanceolate, densely or finely sericeous on both sides, tending to be conduplicate, arcuate, on drying; peduncles 3–5 cm. long; flowers 10–12 mm. long; spur at base of calyx 1–1.5 mm. long; banner reflexed above the midpoint, pubescent over the central area of the back and in the ventral sulcus near the umbos; wings with lateral pubescence near the tip but glabrous on the basal half; keel ciliate along the upper margins but otherwise glabrous; ovules 4–5; pods 20–30 mm. long, 6–8 mm. wide, sericeous to villous.

The variety *montanus* is morphologically very close to the variety *arbustus*. The variety *montanus* is the more common of the two, and the vegetative appearance is more nearly that of a robust subsp. *neolaxiflorus*. The var. *montanus* is found on rocky or gravelly montane slopes with yellow pines or at higher elevations. The smallest specimens of var. *montanus* are from Kittitas County, Washington, where the vegetative characters resemble those of subsp. *neolaxiflorus*, but the flower conformation is typical of var. *montanus*. The specimens cited from Douglas and Chelan counties, Washington (*L. lutescens* C. P. Sm.), morphologically belong with var. *montanus* but apparently there has been introgression from *L. sulphureus*. The white color makes this population look very much like subsp. *calcaratus*, which blends into var. *montanus* across the northern part of Oregon.

Distribution. (partial citation, see Map 1). CALIFORNIA. Kern County: Shirley Creek, Greenhorn Mountains, *Griffith 464* (POM). Los Angeles County: Swartout

Valley, San Gabriel Mountains, *Munz 4607* (POM). Mariposa County: 8 miles west of Glacier Point, *Wiggins 9224* (POM). Siskiyou County: north of Weed, June 12, 1940, *Lewis* (LA).

Idaho. Adams County: Smith Mountain, *Davis 2539* (WS). Nez Perce County: Culdesac, May 20, 1932, *Warren* (WS). County?: Craig Mountains, Sandberg, *MacDougal* & *Heller 226* in part (POM).

Nevada. Douglas County: Spooner, June 23, 1902, *Baker* (POM). Esmeralda County: Emigrant Pass, *Eastwood* & *Howell 231* (CAS).

Oregon. Baker County: Cornucopia, slopes of Wallowa Mountains, *Thompson 13343* (RSA, WS). Powder River Mountains, August, 1896, *Piper* (WS). Benton County: near Corvallis, June 19, 1898, *Kincaid* (WS). Clackamas County: (both the following are probably hybrids with subsp. *silvicola*) opposite Oswego, May 24, 1888, *Millard* (WS); Oswego, May, 1889, *Drake* & *Dickson* (WS). Gilliam County: 3 miles south of Olex, *Hitchcock 19218* (RSA & WS). Jefferson County: Cove Palisade, 13 miles southwest of Madras, *Cronquist 6942* (RSA). Morrow County: between Spray and Hardman, Blue Mountains, *Cronquist 6618* (RSA). Multnomah County: Willamette River, below Portland, *Sheldon S10858* (POM, MO, WS). Sherman County: DeMoss, *Hill 7*; *49* (WS). Union County: source of Two Color Creek, Wallowa Mountains, *Cusick 3187* (MO, WS), *3668* (WS), *3690* (RSA, WS); vicinity of Union, *Cusick 3714* (WS). Wallowa County: Lookout Mountain, Hell's Canyon, *Constance* & *Jacobs 1424* (WS). Wasco County: 5 miles east of Oregon Skyline Trail, Highway 50, *Martin 4815* (RSA, LA, MO, & WS) (an intermediate with subsp. *silvicola*); 25 miles south of Maupin, *Peck 26162* (WS); The Dalles, *Suksdorf 1959, 1961, 1962, 1968, 2185* (WS).

Washington. Asotin County: south of Puffers Butte, *Cronquist 5818* (RSA & WS) (probable hybrid). Chelan County: Wenatchee Mountains, *Hitchcock 17285* (RSA & WS), *Griffiths* & *Cotton 127* (WS). Wenatchee, *Whited 41, 1103* (WS); 25 miles southeast of Wenatchee, *Pickett 1271* (WS). Douglas County: slopes of Badger Mountain, *Thompson 14626* (WTU). Kittitas County: Table Mountain, *Thompson 14887a* in part (RSA); Bald Mountain, *Thompson 14806* (RSA). Klickitat County: Columbus, *Suksdorf 6498* (MO, WS), *6512* (WS); Rockland, Klickitat Mountains, *Suksdorf,* June 12, 1893 (WS), *2306* (MO). Yakima County: Yakima Indian Reservation, Medicine Valley, *Heidenreich 94* (WS).

2c. Lupinus arbustus subsp. neolaxiflorus Dunn, Leafl. West. Bot. 7: 254. 1955. Type. Vicinity of the Falls of the Columbia River (Celilo Falls, probably in Klickitat County, Washington, but also possibly on the south side of Columbia River, Wasco County, Oregon, perhaps as much as 20–40 miles inland, Douglas' hiking range), *Douglas 297,* 20 June 1825 (CGE). *Lupinus laxiflorus sensu* Agardh, *pro parte,* Syn. Gen. Lup. 1835 (not *L. laxiflorus* Dougl. ex. Lindl.). *Lupinus laxiflorus sensu* Torrey and Gray, *pro parte,* Fl. North America, 1840, likewise for the other authors covering western North America (1840–1951). *Lupinus inyoensis* var. *demissus* C. P. Smith, Bull. Torrey Club 51:304. 1924. Type. Wallowa Mountains, Baker County, Oregon, *Peck 5329* (WILL. U.; cotype, DS.). *Lupinus caudatus* var. *submanens* C. P. Smith, Sp. Lup. 106. 1939. Type. Antone Creek, 2 miles east of Anthony Lake, Wallowa County, Oregon, August 10, 1930, *Lyle* (DS). *Lupinus lyleianus* C. P. Smith, Sp. Lup. 107. 1939. Type. Seven miles east of Pearson Ranger Station, Umatilla National Forest, Oregon, July 14, 1930, *Lyle* (DS) (an intermediate with *L. caudatus*). *Lupinus yakimensis* C. P. Smith, Sp. Lup. 238. 1940. Type. Cleman Mountains in alpine sagebrush, 25 miles northwest of Yakima, Washington, *Thompson 14572* (WTU). *Lupinus wenatchensis* Eastw., Leafl. West. Bot. 3:174. 1942. Type. Alpine slopes of Wenatchee Mountains, *Thompson 14242* (CAS). *Lupinus henrysmithii* C. P. Smith, Sp. Lup. 566. 1946. Type. Minidoka National Forest, Idaho, *H. L. Smith 119* (USFS 42539). *Lupinus amniculi-putorii* C. P. Smith, Sp. Lup. 575. 1946 (an intermediate with *L. caudatus* Kell.). Type. Mink Creek, Bannock County, Idaho, July 30, 1935, *Crane* (DS). *Lupinus mackeyi* C. P. Smith, Sp. Lup. 725, 1952. Type. Clifty Block Mountain Range, Kaniksu National Forest, Idaho, *Mackey 65* (USFS 47532). *Lupinus augusti* C. P. Smith, Sp. Lup. 733. 1952 (an intermediate with *L. caudatus* Kell.). Type. Head of Slater Creek, Boise National Forest, Elmore County, Idaho, *Pearce 23* (USFS 64136). *Lupinus stipaphilus* C. P. Smith, Sp. Lup. 733. 1952. Type. North Star Lake, Boise National Forest, Elmore County, Idaho, *Pearce 165b* (USFS 67739). *Lupinus festucasocius* C. P. Smith, Sp. Lup. 738. 1952 (an intermediate with *L. caudatus* Kell.). Type. Copper Basin Potholes, Lemhi National Forest, Idaho, *Johnson 20* (USFS 56432). *Lupinus stockii* C. P. Smith, Sp. Lup. 743. 1952. Type. Bostetter Ranger Station, Minidoka National Forest, Idaho, *Stock 186* (USFS 33836). *Lupinus standingi* C. P. Smith, Sp. Lup. 749. 1952. Type. Deep Creek, near Malad, Cache National Forest, Idaho, *Standing 18* (USFS 44296). *Lupinus laxiflorus* var. *laxiflorus sensu* Phillips *pro parte,* Res. St. State Col. Wash. 23:197. 1955.

Plants 2–4 dm. tall, the stems clumped from a woody caudex, the upper nodes branching later, finely sericeous throughout, the petioles of the basal leaves 8–13 cm. long, slender, present at anthesis; leaflets 8–10, linear-elliptic to linear-oblanceolate, the largest 2.5–5 cm. long, 3–7 mm. wide, pubescent on both sides, the tips acute; peduncles 2–8 cm. long; racemes 7–12 cm. long, lax or dense; bracts subpersistent to caducous; verticels 8–20 mm. distant; pedicels 3–4 mm. long; flowers 8–10 mm. long; upper lip of the calyx 3–4.5 mm. long, with a gibbous base or a short spur 0.2–1.4 mm. long at the base, the lip exposed or partially covered by the sides of the banner, with bracteoles 0.2–1 mm. long; banner obovate to suborbicular, sparsely pubescent in the dorsal grooves and under the calyx lip, or glabrous in about one-fourth of those studied; wings pubescent laterally near the tip in about one-third of those seen, more commonly glabrous; keel minutely and sparsely ciliate along the upper edges; ovules 3–5; pods 24–28 mm. long, 6–7 mm. wide, silky-sericeous.

Included in *L. arbustus* subsp. *neolaxiflorus* is the main mass of material considered by authors since Agardh as *L. laxiflorus*. Its center of distribution is in the mountains of central Washington, extending southward into the northern edge of Oregon and eastward in the Snake River drainage of southern Idaho. It is found in meadows and gravelly valleys and in rolling hills with *Artemisia tridentata* and *Tetradymia*, and on up to rocky slopes in the Ponderosa Pine zone. Some specimens appearing to be hybrids with subsp. *pseudoparviflorus* were collected among aspens and lodgepole pines.

The smaller vegetative habit and the smaller flowers, as well as the fact that the flowers commonly have glabrous wing tips, less pubescence on the back of the banner, and sparse ciliation on the upper edges of the keel, all suggest a close relationship with *L. lepidus*. The vegetative stature of two specimens from Kittitas County, Washington (*Thompson 14806, 14887*, cited under var. *montanus*) and the wing pubescence on the wing tips of some of the individuals from the Wenatchee Mountains (*Hitchcock 17285*), both suggest gene flow between *L. arbustus* var. *montanus* and subsp. *neolaxiflorus*.

Distribution (partial citation). IDAHO. Blaine County: Corral Creek, 15 miles up Morgan Creek, *Hitchcock 14125* (RSA). Smoky Mountains, *Macbride & Payson 3754* (POM). Cassia County: 22 miles east of Rogerson, Goose Creek Mountains Division, *Christ 18490* (NY). Custer County: Salmon River Mountains near Bonanza, *Macbride & Payson 3392* (POM); 28 miles southeast of Patterson, *Christ 17809* (NY). Franklin County: Franklin Basin, head of Cub River, *Christ 16366* (NY). Gooding County: Gooding, *Shoop 117* (UMO) (with some traits of subsp. *pseudoparviflorus*). Idaho County: Heaven's Gate, Seven Devil Mountains, *Q. Jones 215* (RSA). Jerome County: 14 miles west of Eden, *Christ 15420* (NY). Power County: Crystal, 19 miles southwest of Pocatello, *Christ 18559* (NY, an intermediate with *L. caudatus*). Twin Falls County: 12 miles east of Rogerson, *Christ 18485* (NY). Washington County: 17 miles northwest Mann Creek Store at 4th of July Creek, *Christ 17943* (NY).

OREGON. Baker County: Eagle Creek, Wallowa Mountains, *Cusick 2331a* (WS); ridge south of Anthony Lake, Elkhorn Range, *Maguire & Holmgren 26904* (POM & WS); 12 miles northwest of Unity, *Hitchcock 19464* (RSA). Grant County: Indian Springs Road to Strawberry Peak, Blue Mountains, *Maguire & Holmgren 26857, 26858* (WS). Hood River County: 5 miles west of Hood River, *Cooke 17342* (WS); Hood River, *Suksdorf*, June 15, 1883 (WS). Multnomah County: Bonneville, *Suksdorf 1793, 1797* (WS), *Hill 70* (WS). Wasco County: Friend, *Hill 29, 56* (WS); The Dalles, *Suksdorf 2184* (WS). Union County: Two Color Creek, Wallowa Mountains, *Cusick 3692* (WS).

WASHINGTON. Asotin County: road to Blue Mountains, 6 miles from Anatone, *Downen 100* (WS); Anatone, *St. John 9561* (WS); opposite Zindel, *St. John & Rex Brown 3225, 3691* (WS). Chelan County: Boulder Peak, *Thompson 11787* (POM); Tronson Ridge, *Thompson 9320* (POM, MO); Alpine Ridge near Mt. Stuart, *Thompson 9513* (RSA). Columbia County: one mile east of Table Rock, Umatilla National Forest, *Kruckeberg 2524* (RSA). Douglas County: Badger Mountain, northeast of Wenatchee, *Hitchcock 17387* (WS). Kittitas County: Lion Lookout Station, Table Mountain, *Hitchcock, Rethke & van Raadshooven 3616* (LA, RSA, POM & WS); ridge east of Virden, *Thompson 11588* (POM, WS, MO); Salom La Sac, *Thompson 10464* (POM, MO); Iron Mountain, *Thompson 10039* (RSA); hillsides near Yakima River at Cle Elem, *Benson 1257* (POM); Beverly Creek, *Thompson 10039* (POM); Wenatchee Mountains, *Thompson 14242* (WS). Klickitat County: Falls of the Columbia, *Douglas 297* (refer to citation of type); Klickitat, *T. Howell*, May, 1870 (WS); Bingen vicinity, *Suksdorf 10519, 12387, 10491, 10492* (WS); Falcon Valley, *Suksdorf 347; 2569; 7284; 8280* (WS). Skamania County: Dog Creek, *Suksdorf 11664* (WS); "Zahnberg," *Suksdorf*, July 8, 1896 (WS); Chenowith, *Suksdorf 2568* (WS). Yakima County: North of Wenas, *Thompson 14556*, in part (WS).

2d. LUPINUS ARBUSTUS subsp. SILVICOLA (Heller) Dunn, Leafl. West. Bot. 7:255. 1955. *Lupinus silvicola* Heller, Muhlenbergia 6:81. 1910. Type. Placer County, California, near the summit, *A. A. Heller 9857* (Nevada Agri. Exp. Sta.; isotypes MO, POM, MIN, NMC, WS, US). *Lu-*

pinus laxiflorus var. *silvicola* (Heller) C. P. Smith, in Jeps. Man. Fl. Pl. Calif. 527. 1925. *Lupinus lassenensis* Eastw. Leafl. West. Bot. 4:221. 1946. Type. Manzanita Creek, Lassen Volcanic National Park, California, *L. S. Rose 45262* (CAS). *Lupinus laxiflorus* var. *laxiflorus sensu* Phillips *pro parte*, Res. St. State Col. Wash. 23:197. 1955.

Plants 4.5–5 dm. tall, with several stems from a woody caudex, the stems minutely appressed-pubescent to puberulent throughout; leaves cauline with the petioles gradated, 10 cm. long below and 3–4 cm. long above; leaflets 8–10, linear-elliptic, puberulent on both sides, bright green, obtuse or acute, mucronate; peduncles 2–4 cm. long; racemes 8–10 cm. long, flowers scattered or subverticils 8–15 mm. distant; bracts tardily deciduous; pedicels slender, 2–5 mm. long; flowers 6.5–10 mm. long; upper lip of the calyx 3–5 mm. long, the spur ca. 1 mm. long, the tip usually covered by the sides of the banner; banner pubescent dorsally and in the ventral sulcus; wings pubescent laterally near the tip; keel villous-ciliate near the acumen; ovules 4–5; pods 20–25 mm. long, 6–7 mm. wide, finely sericeous.

Lupinus arbustus subsp. *silvicola* is centered in the northern Sierra Nevada of California, extending into the Cascade Range of Oregon. It is most commonly found from the arid transition zone, with yellow pine, into the upper Canadian zone, with spruce and white pine. Occasional specimens have been collected at lower elevations. This taxon grades into var. *montanus* in the north and subsp. *calcaratus* along the Sierra Nevada. Gene flow from subsp. *silvicola* was probably responsible for the blue-flowered specimens of subsp. *calcaratus* in northeastern California, which Eastwood called *L. elegantulus,* since these specimens resemble subsp. *silvicola* in being less hairy, but they have the flower proportions of subsp. *calcaratus*. Several of the specimens cited under var. *montanus* from the Mt. Hood area (*Martin 4815;* Oswego, *Millard;* Oswego, *Drake & Dickson*) show characters which suggest gene flow from subsp. *silvicola*. *Christ 16868,* cited below from Deschutes County, Oregon, is closer to the typical subsp. *silvicola,* but shows traits of var. *montanus*.

Distribution (partial citation). CALIFORNIA. Alpine County: Winnemucca Lake, Woods Lake region, *Peirson 12799* (RSA); Lake Alpine region, *Peirson 11579* (RSA). Butte County: Jonesville, *Copeland 421* (LA, POM, RSA, MO). Eldorado County: trail to upper Echo Lake, *Peirson 6309* (RSA). Lassen County: west of Fredonyer Pass, *Heller 15142* (RSA, POM, MO). Mariposa County: Inspiration Point, Yosemite, June 5, 1897, *Congdon* (MIN). Modoc County: Fandango Pass, Warner Mountains, *Eastwood & Howell 8141* (CAS). Nevada County: Castle Peak, *Howell 18531* (RSA); Donner Lake, *Heller 6944* (POM, MIN, MO); Independence Lake, *Hall & Babcock 4532* (POM); Soda Springs, *M. E. Jones 2406* (POM); Truckee, July, 1895, *C. F. Sonne* (POM). Placer County: Deerpark, Lake Tahoe region, *Eastwood 405* (RSA, MO); Summit, *Heller 9857* (see type citation). Plumas County: Eureka Peak, *J. T. Howell 27699* (RSA); Warner Valley, *Applegate 5781* (RSA); Silver Lake, July 13, 1929, Merrill (WS, MO). Shasta County: slope of Diamond Peak, *Dunn 11812* (RSA, LA & MIN); Lassen Peak, *M. E. Jones 11658* (POM); trail, Drakesbad to summit of Lassen Peak, *Peirson 6815* (RSA); two miles east of Hatchet Summit, *Heller 15688* (WS, MO). Sierra County: between Gold Lake and Blaisden, *Barker 766* (RSA). Siskiyou County: east of Deer Mountain, *Heller 15260* (RSA, MO). Tehama

County: Mineral, July 16, 1935, *Epling* & *Robison* (LA); two miles east of Chico Creek, Highway 32, *Heller 15672* (WS, MO).

OREGON. County ?: Woodville, *T. Howell 1341* (MO). Crook County: mouth of Canyon Creek, Ochoco National Forest, *Kucera 19, 22* (WS); Tumale Ditch, *Whited 624* (WS). Deschutes County: Santiam Pass northeast of Sisters, *Christ 16868* (NY). Klamath County: near Fort Klamath, *Applegate 4096* (RSA, WS). Wasco County: Marion's Point Lookout, Mount Hood National Forest, *G. N. Jones 4028* (POM).

2e. LUPINUS ARBUSTUS subsp. CALCARATUS (Kell.) Dunn. Leafl. West. Bot. 7:255. 1955. *Lupinus calcaratus* Kell. Proc. Calif. Acad. Sci. 2:195, f. 60. 1862. The illustration becomes the type since the type was lost in the San Francisco fire (International Code, 1952, Art. 21). Type locality not given but probably western Nevada or adjacent California, specimens distributed by P. Train from Convict Creek, Mono County, California, May 30, 1937, may be considered as typical. *Lupinus variegatus* Heller, Muhlenbergia 8:89. 1912. Type. Ruby Mountains near Deeth, Elko County, Nevada, *Heller 10551* (Nevada Agri. Exp. Sta.; isotypes, POM, MIN, NMC). *Lupinus multitinctus* A. Nels. Bot. Gaz. 53:221. 1912. Type. Big Willow Canyon, Idaho, *J. F. Macbride 114* (isotypes MIN, WS, MO). *Lupinus laxiflorus* var. *calcaratus* (Kell.) C. P. Smith, Bull. Torrey Club 51:304. 1924. *Lupinus laxiflorus* var. *villosulus* C. P. Smith, Am. Jour. Bot. 13:530. 1926. Type. Clove Mountains near Deeth, Nevada, *Heller 9098* (DS). *Lupinus elegantulus* Eastw. Leafl. West. Bot. 3:20. 1941 (an intermediate with subsp. *silvicola*). Type. Fandango Pass, Warner Mountains, Modoc County, California, *Eastwood* & *Howell 8141* (CAS). *Lupinus noldekae* Eastw. Leafl. West. Bot. 4:149. 1945. Type. Near Hot Creek, Mono County, California, July 1938, *A. Noldeke* (CAS). *Lupinus geraniophilus* C. P. Smith, Sp. Lup. 727. 1952. Type. Johnson Creek Ranger Station, Weiser National Forest, Idaho, *H. J. Helm 30* (USFS 44172). *Lupinus varneranus* C. P. Smith, Sp. Lup. 730. 1952 (an intermediate with *L. argenteus* var. *tenellus*). Type. Boulder Lake, Idaho National Forest, Idaho, *I. M. Varner 82* (USFS 17912). *Lupinus multitinctus* var. *grandjeani* C. P. Smith, Sp. Lup. 735. 1952. Type. Boise National Forest, Elmore County, Idaho, *E. Grandjean 460* (USFS 27399). *Lupinus graciliflorus* C. P. Smith, Sp. Lup. 739. 1952. Type. Fairview Ranger Station, Lemhi National Forest, Idaho, *G. A. Miller M-86* (USFS 63045). *Lupinus laxiflorus* var. *laxiflorus sensu* Phillips *pro parte,* Res. St. State Col. Wash. 23:197. 1955.

Plants generally 4–6 dm. tall with a cluster of stems from a woody caudex, branching above after the primary raceme reaches anthesis, puberulent to finely sericeous and occasionally strigose to somewhat villous; leaves all cauline, the lower petioles up to 15 cm. long, gradated to 2 cm. long above; leaflets 8–10, linear-elliptic-oblanceolate, pubescent on both sides, the largest 3–6 cm. long and 4–8 mm. wide; peduncles 2–3 cm. long; racemes 5–10 cm. long, rather dense, the flowers scattered or verticillate, the verticils 8–10 mm. distant; bracts subpersistent to caducous; pedicels 3–4 mm. long; flowers 11–14 mm. long excluding the spur; upper lip of the calyx 6–7 mm. long, including the spur of 1.6–3 mm. in length, the lower lip 5.5–6.5 mm. long; banner with abundant pubescence on the back or sparsely ciliate in the dorsal grooves, rarely glabrous, also pubescent in the ventral sulcus; wings pubescent laterally near the tip, keel ciliate toward the acumen; ovules 5–6; pods 25–35 mm. long, 8–10 mm. wide, villous.

The subsp. *calcaratus* occupies the mountains of the northern Great Basin, commonly in the *Artemisia* and *Juniperus* belt, but some intermediates are known to extend up into the spruce zone. The blue and lavender forms grade into subspecies *arbustus* var. *montanus*. The flowers of subsp. *calcaratus* are more slender and the calyx spurs longer than those of subsp. *arbustus* var. *montanus*. The upper lip of the calyx may be exposed or partially hidden by the banner. In its typical yellow-white form, it is quite distinct. There also appears to be gene flow between subsp. *calcaratus* and subsp. *silvicola* in the Sierra Nevada of California. The effects of introgression are also apparent between subsp. *calcaratus* and subsp. *pseudoparviflorus* in Idaho.

Distribution (partial citation). California. Alpine County: Leviathan Creek, *J. C. Johnson 121* (WS). Inyo County: (w)[1] Andrews Camp, Bishop region, *Peirson 529* (RSA). Lassen County: (b) 14 miles west of Madeline, *Balls 14788* (RSA). Modoc County: (b) *Austin & Bruce 2146* (POM); (lav) Canby Bridge, *Balls 14742* (RSA); (b) Cedar Pass, *Heller 16205* (RSA); (w) below Clear Lake, *Balls 14798* (RSA). Mono County: (w) Convict Lake, *Woglum 1875* (RSA), May 30, 1937, *Train* (UMO); (lav-w) Sonora Pass, *A. L. Grant 348, 159, 313* (POM, MO); (w) Long Valley, *Fendge 1496* (POM); Virginia Lakes Basin, *Peirson 11215* (RSA); Hot Creek region, *Peirson 12439* (RSA). Plumas County: (lav) five miles north Chilcoot, *Munz 11822* (RSA). Tuolumne County: (b-lav) Sonora Pass, *Wiggins 8127* (RSA).

Idaho. Ada County: (w) Boise, *Clark 13* (POM, WS); Owyhee, *M. E. Jones 25464* (LA). Blaine County: (lav–w) Galena Summit, *Macbride 3719* (POM, WS, MO). Boise County: (yel-w) Squaw Creek (Sweet), *Macbride 844* (POM, WS, MO). Custer County: (an intermediate with *L. leucophyllus*) 5 miles west of Basingers, Little Lost River Valley, *Hitchcock 15729* (RSA); (law-w) Malkay, *Nelson & Macbride 1530* (POM, WS, MO). Elmore County: 15 miles north of Mountain Home, *Hitchcock & Muhlick 8670* (WS, MO); 3 miles east of Featherville, *Hitchcock 8780* (WS, MO). Twin Falls County: southeast of Hollister, *Piemeisel 44, 1032* (RSA). Washington County: Weiser, *M. E. Jones,* July 7, 1899. (POM, MO).

Nevada. Douglas County: (lav-w) Glenbrook, *Smith 3803* (POM); Kingsbury Grade to Lake Tahoe, *Train 3161* (RSA); (lav-w) Spooner, *Smith 3808* (POM), (lav-b) June 23, 1902, *Baker* (POM). Elko County: 6 miles east of Wells, *Train 3639* (RSA); near Deeth, *Heller 9098* (UC); Ruby Mountains near Deeth, *Heller 10550, 10551* (POM, MIN, Nevada Agri. Exp. Sta.). Esmeralda County: Emigrant Pass, Victory Highway, *Eastwood & Howell 231* (RSA). Ormsby County: (lav-w) Kings Canyon, *Baker 923* (POM, MO); (w) Snow Valley Mountains, *Smith 3837* (POM). Washoe County: Alum Creek, *Heller 9744* (WS); 2.5 miles northeast of Mount Rose Pass, *Martin 5539* (RSA, MO); (w) Franktown, *Jones 3812* (POM), *3815* (MO); (w) Kennedy Pass, Mount Rose, *Heller 10342* (POM, WS, MO).

Oregon. Baker County: north of Robbinette, *Cronquist 6524* (WS). Harney County: Andrews, *Applegate 5635* (WS). Malheur County: 10 miles east of Ironside, *Peck 26065* (WS); Jamieson, *Peck 26059* (WS). Sherman County: DeMoss, *Hill 12*

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[1] The letters in parentheses at the begining of each citation refer to the color of the flowers of the specimen: (w)=white. (b)=blue. (lav)=lavender. (yel)=yellow.

(WS), *43175* (WS). Cassia County: 23 miles east of Rogerson, *Christ 18496* (NY). part, *Cusick 1896* (POM, WS, MO); (lav) Lower Powder River, *Cusick 2514* (POM, WS, MO). Wheeler County: 15 miles northeast of Mitchell, *Cronquist 6977* (RSA); John Day River, 1 mile south of Service Creek, between Fossil & Mitchell, *Cronquist 6304* (RSA, WS).

UTAH. Tooele County: (w) Mount Ibapah, *M. E. Jones 11662* (POM, MO), *Jones,* June 23, 1891 (POM).

2f. LUPINUS ARBUSTUS subsp. PSEUDOPARVIFLORUS (Rydb.) Dunn, Leafl. West. Bot. 7:255. 1955. *Lupinus pseudoparviflorus* Rydb. Mem. N. Y. Bot. Gard. 1:232. 1900. Type. Bridger Mountains, Montana, *Rydberg & Bessey 4441* (NY; isotypes MIN, WS). *Lupinus laxiflorus* var. *pseudoparviflorus* (Rydb.) C. P. Sm. & St. John in St. John, Fl. S. E. Wash. 227. 1937. *Lupinus laxispicatus* Rydb. Bull. Torrey Club 34:42. 1907. Type. High mountains of Kootenai County, Idaho, *J. H. Sandberg,* July, 1887 (NY). *Lupinus laxiflorus* var. *durabilis* C. P. Smith, Journ. Bot. 13:529. 1926. Type. Bonner County, Idaho, Priest River Range, *J. B. Lieberg 2731* (isotype, US). *Lupinus laxispicatus* var. *whithamii* C. P. Smith in St. John, Fl. S. E. Wash. 227. 1937. Type. Junction of Divide and King Creek trails, Kaniksu National Forest, Washington, *C. P. Smith, St. John & Whitham 4170* (DS-Sm; isotype and paratypes at WS). *Lupinus sulphureus* subsp. *whithamii* (C. P. Smith) Phillips, Res. St. State Col. Wash. 23:193. 1955. *Lupinus laxiflorus* var. *elmerianus* C. P. Smith, Sp. Lup. 106. 1939. Type. Paradise, Wallowa County, Oregon, *E. I. Applegate 6483* (DS). *Lupinus mucronulatus* var. *umatillensis C. P. Smith,* Sp. Lup. 108. 1939. Type. Table Rock, Umatilla County, Oregon, July, 1930, *Eldon W. Lyle* (DS). *Lupinus fieldianus* C. P. Smith, Sp. Lup. 567. 1946 (an intermediate with subsp. *neolaxiflorus* Dunn). Type. Thorn Creek, Idaho National Forest, Idaho, *R. C. Fields 224* (USFS 23418). *Lupinus lacus-payetti* C. P. Smith, Sp. Lup. 574. 1946. Type. Payette Lake, Idaho, *M. E. Jones 6251* (POM, MO, US).

Plants 3–6 dm. tall, with several simple stems from a woody caudex, these branching later from the upper nodes, the stems 1.5–2.5 mm. in diameter, finely, thinly sericeous, with basal leaves generally present at anthesis; petioles of the basal leaves 8.5–15 cm. long, those of the upper cauline leaves 2.5–3 cm. long; leaflets 7–11, the largest 4–6 (–8) cm. long and 6–10 mm. wide, the tips rounded, or obtuse to acute in intermediate forms; leaflets commonly glabrous on the upper surface, the intermediate forms sparsely pubescent; peduncles 3–6 cm. long; racemes 3–12 cm. long, lax or dense; bracts caducous or tardily deciduous; flowers 9.5–13 mm. long; pedicels 3–5 mm. long, sometimes up to 10 mm. long; upper lip of the calyx gibbous or with a spur 0.6–1.4 mm. long, the tip usually covered by the sides of the banner; banner finely pubescent in the central area or glabrous in 10–30 per cent of the specimens; the wings glabrous in about 30 per cent of the specimens, the others pubescent near the tip; the keel ciliate above near the acumen, sometimes glabrous; pods 7.5–9 mm. wide, 25–35 mm. long, villous, with 3–6 ovules.

Lupinus arbustus subsp. *pseudoparviflorus* is found in relatively moist habitats but with some drainage, often in considerable shade, from the Douglas fir or lodge-pole pine zones on up to the aspen, spruce and white-pine zones. The center of distribution is in the mountains of western Montana and northern Idaho and southward into Colorado. The occasional plants in the mountains of southern Idaho and the one collection from northeastern Nevada may be thought of as relictual populations.

The material treated here as subsp. *pseudoparviflorus* is somewhat heterogeneous, and breeding studies may reveal that some of the taxa cited as synonyms may require recognition. Smith's var. *elmerianus* is intermediate to subsp. *arbustus* var. *montanus,* having the acute leaflet tips of that variety and a vegetative habit which approaches it, but having glabrate upper leaf surfaces. The two specimens of *L. scheuberae* Rydb. which were seen resemble subsp. *pseudoparviflorus* and have been included in the synonymy of *pseudoparviflorus* by authors, but the flower size of 14 mm. and the vegetative characters suggest to me that *L. scheuberae* may have resulted from hybridization between *L. burkei* S. Wats. and subsp. *pseudoparviflorus.* I have not included *L. scheuberae* here as a synonym of the latter taxon since the morphological hiatus suggests it may warrant treatment as a named hybrid. There is also a race of subsp. *pseudoparviflorus* present in the Bitterroot Valley, Missoula, Montana, which is one of the more distinctive segregates. This race has the narrowest leaflets, racemes up to 25 cm. long, pedicels to 10 mm. long, and becomes 7–9 dm. tall. It has not been named, but it is far more distinctive than most of the variants that have names. It seems best at present merely to call attention to the fact that these plants form what appears to be a morphological extreme within the range of variation attributed to *pseudoparviflorus.*

The var. *whithamii* C. P. Smith may warrant recognition, but the "glabrous wings" which characterize this variety occurred in a high percentage of the specimens in subsp. *neolaxiflorus,* as well as in a fair percentage of the rest of the population of subsp. *pseudoparviflorus.* The highest percentage of individuals that were glabrous in one or more of the flower parts occurred in the population in northern Idaho and Washington. The glabrous nature was observed again in the specimens from Colorado, but there it appears to be due to introgression from *L. rubricaulis* of the *L. argenteus* complex.

Distribution (partial citation). COLORADO. Larimer County: near North Park, Aug., 1894, *Osterhaut* (PHIL). County?: Ursten's Pass, July, 1873, *Coulter* (PHIL).

IDAHO. Bonner County: Priest River, Experimental Forest, *Daubenmire 43122* (WS), *43175* (WS). Cassia County: 23 miles east of Rogerson, *Christ 18496* (NY). Bear Lake County: 13 miles west of Bloomington, *Christ 18678* (NY). Clearwater County: above Orofino, *Constance, Dimond, Rollins & Worley 1082* (WS). Idaho County: Indian Post Office, *Q. Jones 293* (RSA); 5 miles south of Harpster, cliffs above Clearwater River, *Hitchcock & Muhlick 8452* (WS). Latah County: 8 miles south of Troy, *Daubenmire 46131* (WS); Paradise Ridge, *Daubenmire 37403* (approaches *L. scheuberae*) (WS). Lemhi County: 6 miles north of Gibbonville, Salmon

River, *Christ* & *Ward 14695* (NY); Panther Creek 8 miles north of Cabin Creek, *Hitchcock 14270* (POM, RSA). Lewis County: Mission Creek, *St. John, Cary, Putnam* & *Warren 3247* (WS); north edge of Winchester, *Daubenmire 46237* (WS). Nez Perce County: near Lewiston, *Heller 3224* (WS, MO); bluffs of Clearwater River north of Spalding, *Daubenmire 37479* (WS). Shoshone County: Siwash Peak, St. Joe National Forest, *Moore 433* (WS); sidès of Quarles Peak, *Wilson 193, 211, 205,* the latter approaching *L. scheuberae* (WS).

MONTANA. Flathead County: southeast of McDonald Lake, *Hitchcock 18280* (RSA, WS); Columbia Falls, *Dunn 9723* (RSA, LA, MIN, UMO), June, 1894, *Williams* (UMO). Gallatin County: Bridger Mountains, 1 mile south of Brackett Creek, *Hitchcock* & *Muhlick 12460* (WS, MO); Middle Creek Canyon, Bozman, *Blankinship,* June 26, 1900 (WS). Lake County: 10 miles northeast Polson, Flathead Lake shore, *Hitchcock 15344* (RSA, WS). Lewis & Clark County: 3 miles east of Danaher Ranger Station, *Hitchcock 18718* (RSA, WS). Missoula County: Bitterroot Valley, *M. E. Jones 11655* (POM); Rattlesnake Drainage, *Hitchcock 14560* (RSA, WS). Park County: 15 miles south of Wilsall, *Hitchcock* & *Muhlick 12438* (WS). Powell County: 8 miles northeast of Helmville, *Hitchcock 17843* (RSA, WS). Ravalli County: Palisade Pl. Ranger Station, Bitterroot Mountains, *Hitchcock 15344* (RSA). Sanders County: 3 miles west of Dixon, *Hitchcock 2873* (WS). County?: Nanicke, *Cooke 17324* (WS).

OREGON. Wallowa County: Paradise, *Applegate 6483*; east of Sacajawea Camp over the Snake River Canyon, *Kruckeberg 2456* (RSA, WS).

WASHINGTON. Chelan County: Mission Canyon, 10 miles south of Cashmere, *Hitchcock 17304* (WS); 15–20 miles up Wenatchee River, near Cascade Mountains, 1889, *Vasey 38752* (WS). Okanogan County: head of Cedar Creek, south of Conconully, *Fiker 831, 832, 883* (WS). Pend Oreille County: divide & Kings trail, junction, Kaniksu National Forest, *Smith, St. John* & *Whitham 4171, 4177* (WS); Kings Lake Road, below south Skookum Drive, Kaniksu National Forest, *Smith, St. John* & *Whitham 4169, 4180* (WS). Spokane County: Newman Lake, *Smith* & *St. John 4135, 4136* (WS).

University of Missouri,
Columbia, Missouri.

LITERATURE CITED

AGARDH, JACOB G. 1835. Synopsis Generis Lupini. Lundae, Carlos Fr. Berling.

ANDERSON, EDGAR. 1949. Introgressive Hybridization. Wiley & Sons Inc. New York.

DOUGLAS, DAVID. 1914. Journal kept by David Douglas during his travels in North America, 1823–1827. Royal Hort. Soc. London.

DUNN, DAVID B. 1954. A method of mounting pressed flowers for study and preservation. Rhodora 56:258–260.

————. 1955. A new subspecies and new combinations in Lupinus. Leafl. West. Bot. 7:254–5.

————. 1956a. Leguminosae of Nevada, Part 2—Lupinus. Contr. toward a Flora of Nevada, No. 39. Bureau of Plant Industry, U. S. Dept. Agri. Washington, D.C.

————. 1956b. The lupines collected by David Douglas from 1825–1827: their type localities and nomenclature. Leafl. West. Bot. 8:47–54.

GOLDSCHMIDT, RICHARD B. 1952. Evolution, as viewed by one geneticist. Amer. Sci. 40:84–98.

INTERNATIONAL CODE OF BOTANICAL NOMENCLATURE. 1952. Utrecht, Netherlands.

LAWRENCE, DONALD B. 1950. Paper presented at Columbus, Ohio, A. I. B. S. meetings (unpublished).

PHILLIPS, LYLE. 1955. A revision of the perennial species of Lupinus of North America. Res. St. State Coll. of Wash. 23:161–201.

PURSH, F. 1814. Flora Americae Septentrionalis. White, Cochrane & Co., London.

SOME ADDITIONS TO THE CALIFORNIA MOSS FLORA

HOWARD CRUM[1]

Considerable work has been done on the moss flora of California during recent years, and a firm basis has been laid for further floristic studies by the publication of a checklist of California mosses by Koch (1950). The size of the state and the extreme diversity of available habitats make it probable, however, that many more species will be discovered in California, not only by careful collecting but also by critical study of many difficult genera, particularly of the Pottiaceae and the Brachytheciaceae. Recently, from 1954 to 1956, Wilfred B. Schofield of Wolfville, Nova Scotia, made a sizable and very interesting collection of mosses in central California, mostly in the San Francisco Bay region. In addition to many rarities previously recorded from the area, he found one very distinctive new species and several important range extensions which are reported below. A few additional specimens worthy of recording here were sent me for determination or confirmation by Mrs. Fay A. MacFadden of Los Angeles. All the specimens are deposited in the Herbarium of the National Museum of Canada (CAN).

Hymenostomum (Kleioweisia) **inoperculatum** sp. nov. (Figs. 1–6). Planta tenella, usque ad 1 mm., sordido-viridis, paucifoliatus, folia usque ad 2 mm. longa, madida patula, sicca crispula, inferiora minuta et ovata, caetera sensim major, oblongo-lanceolata, acuta et apiculata, concava, marginibus integerrimis, superne late involutis; costa basi 48–56μ., breviter excurrens; cellulae basilares in dimidio inferiore hyalinae, oblongae, parietibus tenuibus, cellulae laminae superioris hexagonae, opacae, densissime papillosae, dioicum (?); flos masculae non vidi, seta 3 mm. longa, pallida, erecta; capsula 1.25–1.75 mm. longa, exserta, erecta, oblongo-cylindrica, oblique et longe rostrata, clausa, sine operculo, sporae 16–19μ., minute et dense papillosae.

Type. On soil in garden in front of Sequoia Hall, Stanford University, Santa Clara County, California, February, 1955, *W. B. Schofield* (*s.n.*); growing with *Pottia arizonica* var. *mucronulata* Wareham (CAN).

This species is distinct from all other American species of *Hymenostomum* known to me in having clearly exserted, cleistocarpous capsules. It is related, perhaps most closely, to *H. exsertum* (Broth.) Broth. of China and Japan, but judging from the single Japanese specimen which I have seen, named by Dr. Akira Noguchi and kindly communicated by Dr. Harumi Ochi, the Californian species differs markedly in having much shorter and relatively broader leaves which are less strongly crisped when dry and capsules which are narrower and cylindric to subelliptic, rather than subglobose, and end in longer, more slender beaks. A further difference is that the capsules are clearly exserted, and the setae much exceed the uppermost leaves in length, whereas in *H. exsertum,* although the

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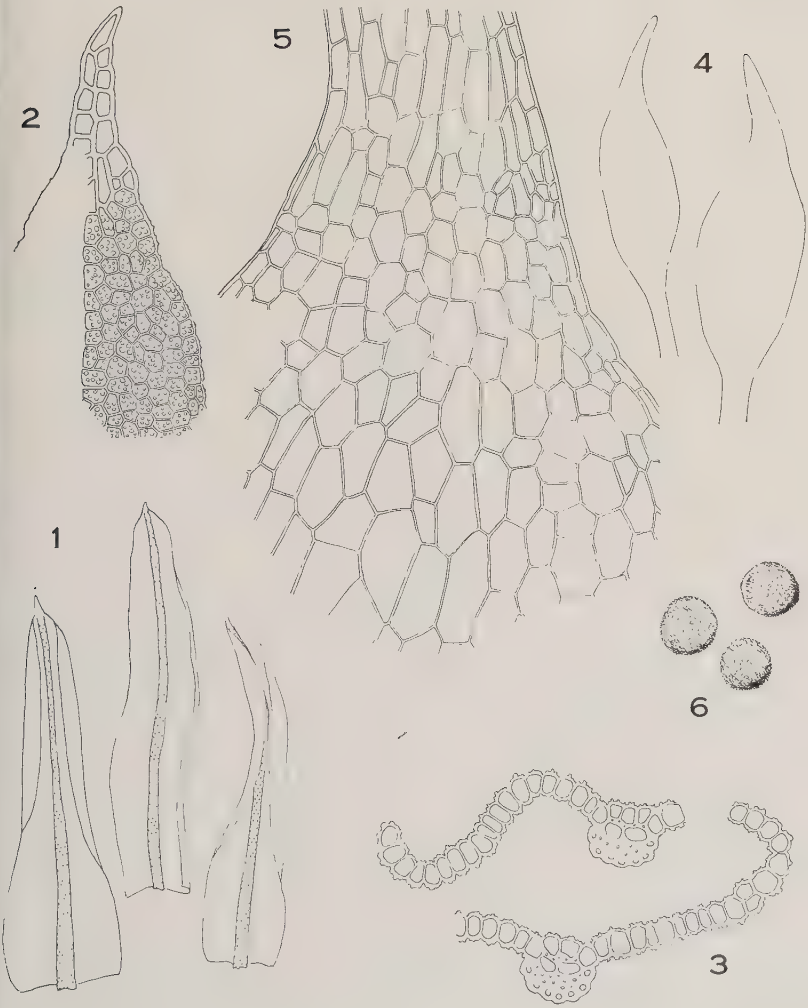
[1] Published by permission of the Director of the National Museum of Canada, Ottawa.



FIGS. 1–6. *Hymenostomum inoperculatum*. 1, leaves, × 30; 2, upper cells of leaf and apiculus, × 275; 3, two sections taken in upper portion of leaf, × 275; 4, two capsules, × 30; 5, areolation of capsule wall showing the irregularity of cells at the zone of dehiscence in most other species of mosses, × 275; 6, spores, × 520.

setae are fairly long and the capsules appear to be exserted, they are actually surpassed in length by the strongly contorted and spreading upper leaves. *Hymenostomum inoperculatum* conforms very well to the description of *H. semidiaphanum* Thér. of Mexico, but the type of that species was examined and found to be inaccurately characterized. The operculum is clearly differentiated and not "haud secedens." (Thériot was probably misled by the juvenile development of the capsules in the type collection of *H. semidiaphanum.*) The position of *H. semidiaphanum* in the subgenus *Kleioweisia* seems highly unlikely.

POTTIA ARIZONICA var. MUCRONULATA Wareham. On soil in garden in front of Sequoia Hall, Stanford University, Santa Clara County, February, 1955, *W. B. Schofield* (*s.n.*). I have examined the only previous California collection, from Los Angeles County (Koch, 1950), as well as the type from Arizona.

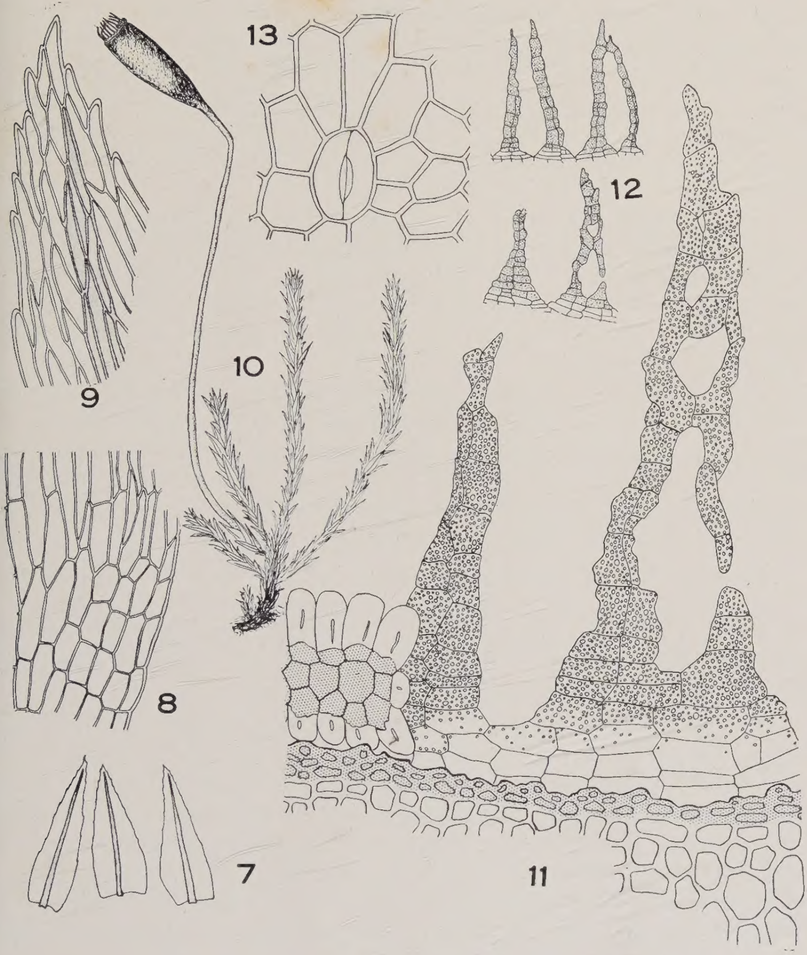
STEGONIA LATIFOLIA var. PILIFERA (Brid.) Broth. This interesting moss, previously known only from the Yukon and from the Canadian Rocky Mountains in North America, was collected among rocks at 13,950 feet altitude on Mount Barnard, Tulare County, by Peter H. Raven on July 25, 1955. The specimen was sent me by Mrs. MacFadden.

TORTULA STANFORDENSIS Steere. On moist, hard-packed soil of open area, Purissima Creek, San Mateo County, November 8, 1955, *W. B. Schofield 6322*. This species, recently described from Santa Clara County (Steere, 1951), has also been reported from Alameda County (Koch & Ikenberry, 1954).

GRIMMIA MARINIANA Sayre. Dark, hyaline-tipped cushions among boulder crevices, Mount Tamalpais, Marin County, March 26, 1955, *W. B. Schofield 5798*; steep, exposed rocks, east side of East Peak, Mount Tamalpais, Marin County, April 8, 1956, *John T. Howell H184* (comm. Mrs. MacFadden). Both of these specimens come from the general vicinity of the type locality and conform very well to Sayre's recent description (1955), except that the alar cells of the leaves have thickened cross-walls, a character which Sayre perhaps overlooked.

EPHEMERUM MINUTISSIMUM Lindb. Locally abundant on small, clayey patches in an open field, Big Basin, Santa Cruz County, March 24, 1956, *W. B. Schofield 6450*; local, on bare patches near margin of field, near Ventura Hall, Stanford University, Santa Clara County, February 23, 1955, *W. B. Schofield 5723*. Duplicates of these specimens were sent to Dr. Virginia S. Bryan, who confirmed the determinations tentatively, pending further understanding of the puzzling variation exhibited by *E. serratum* and *E. minutissimum* in the West. Koch (1950) listed only *E. serratum* (Hedw.) Hampe from California, where it had been collected only once, in San Francisco. Grout (1928–40) mentioned only Massachusetts and Saskatchewan in the distribution of *E. minutissimum*.

MIELICHHOFERIA MIELICHHOFERIANA (Funck) Limpr. (figs. 7–13). On a tree trunk, Little Butano Creek, Santa Clara County, November 6, 1954, *W. B. Schofield 5748*. Extremely rare and localized in its distribution, this species has been collected in only a few other widely separated places in North America (in the Lake Superior region of Michigan and Ontario and also in Maine). In the Old World it is known from Scandinavia, the Alps and elsewhere in Central Europe, the Pyrenees, and the Caucasus. The plants which Mr. Schofield collected in the Coast Ranges



FIGS. 7–13. *Mielichhoferia mielichhoferiana.* 7, leaves, × 23; 8, basal cells of leaf, × 205; 9, upper cells of leaf, × 205; 10, habit of fruiting plant, × 8; 11, portion of peristome, annulus, and upper exothecial region, × 205; 12, portions of peristomes, showing variation in shape of teeth, × 65; 13, cells from neck of capsule showing stoma, × 205.

of central California seem to me typical in every structural detail and only slightly different in habit of growth, as they are somewhat more elongate, less densely compacted in tufts and more loosely and freely branched than any other material that I have examined, although they greatly resemble in growth form the illustrations given in the "Bryologia Europaea" (plate 328, as *M. nitida* Hornsch.) and reproduced in Grout's "Moss Flora of North America." These differences are indeed slight and almost surely not of a genetic nature, and they are doubtless associated with the unusual habitat in which the plants were found, namely, on the bark of a tree. Insofar as I have been able to ascertain, the species has never before been reported from any substrate other than rock and, more specifically, from rocks containing alum or iron and copper ions. Persson (1948) has recently reviewed the evidence for believing that the genus *Mielichhoferia* shows a predilection for copper-containing rocks.

More typically developed, though sterile, plants of a *Mielichhoferia,* tentatively named *M. mielichhoferiana* by A. LeRoy Andrews, were also collected in California by John Thomas Howell "on shaded, moist rock, Merced River Canyon, just above Briceburg, Mariposa County." They were recently sent to me by Mrs. MacFadden, and I see no reason to doubt the determination.

I have prepared the accompanying camera lucida drawings in order to give greater publicity to *M. mielichhoferiana,* as this interesting and rarely collected species has not been illustrated from American material before. It should be noted that the shape of the capsule varies with age. When old, empty and somewhat wrinkled, it is oblong-cylindric, but when operculate, it is more ovoid with a more distinct neck.

ZYGODON VIRIDISSIMUS (Dicks.) Brown. In crevices of bark of *Lithocarpus,* forming small patches, Big Basin, Santa Cruz County, November 27, 1955, *W. B. Schofield 6371.* Subsequent to the publication of his checklist, Koch (1950a) reported this species for the first time from California, from a collection made in Humboldt County.

BRACHYTHECIUM WASHINGTONIANUM Eaton ex Grout. On shaded soil bank, Purissima Creek, San Mateo County, November 8, 1956, *W. B. Schofield 6337*; on wet bank, same locality and date, *6346*; rock outcropping of brook bank, Big Basin, Santa Cruz County, November 27, 1955, *W. B. Schofield 6357.* Koch (1950) listed three collections of this species from Trinity, Siskiyou, and Humboldt counties. These collections extend the range southward considerably. I have studied the type, which comes from Washington. The alar cells of the stem leaves are large and lax and much more clearly differentiated than Grout (1928–40) indicated and seem to me indicative of a clearer relationship to *B. rivulare* B.S.G. than Grout appears to have realized.

National Museum of Canada
Ottawa, Canada

LITERATURE CITED

GROUT, A. J. 1928–40. Moss flora of North America north of Mexico. 3 vol. Newfane, Vt.

KOCH, L. F. 1950. Mosses of California: an annotated list of species. Leafl. West. Bot. 6:1–40.

————. 1950a. Mosses of California. II. Zygodon viridissimus. The Bryologist 53:213–215.

———— & G. J. IKENBERRY. 1954. Preliminary studies of California mosses. II. The Bryologist 57:291–300.

PERSSON, H. 1948. On the discovery of Merceya ligulata in the Azores with a discussion of the so-called "copper mosses." Rev. Bryol. et Lichénol. 17(1/4):75–78.

SAYRE, GENEVA. 1955. Grimmia mariniana, a new species from California. The Bryologist 58:323–325. Fig. 1.

STEERE, W. C. 1951. Tortula stanfordensis, a new species from California. The Bryologist 54:119–123. Figs. 1–9.

REVIEW

The Genus Nicotiana. By T. H. GOODSPEED. xxi + 536 pp., illustrated. Chronica Botanica Vol. 16, No. 1/6. 1954. Waltham, Mass.: The Chronica Botanica Co.; San Francisco, Calif.: J. W. Stacey, Inc. Buckram. $12.50.

According to Professor Goodspeed: "The primary objective of the *Nicotiana* investigations . . . has been the accumulation of evidence bearing upon the origin, evolution and relationships of the modern species of the genus (p. 1)." Merely as a general presentation of this accumulated information this book is impressive. As Volume 16 of *Chronica Botanica,* it contains some 536 pages, 50 tables, and 118 plates as well as text-figures. Studies in distribution, morphology, and cytogenetics (comprising the first four parts of the book), many of which began as long ago as 1904, are discussed in detail. The important contributions of the *Nicotiana* work to general genetics and cytology are not touched upon, however, for obvious reasons. It is very useful, of course, to have all of this material, which has appeared in many different journals over the years, brought together and integrated. One cannot fail to be impressed with the Olympian outlook of the author as he discusses a genus which has contributed so much to an understanding of basic biological problems. One must always keep in mind, however, that, in a summary work of this sort, there is a great deal more interpretation, or even opinion, than in the individual contributions.

Part I is concerned with the evidence from distribution. Since there is no paleobotanical evidence to use in determining past distribution, Goodspeed discusses in detail the present distribution upon the major land masses. Much of this is repetitive from chapter to chapter and speculative, and suffers from the defects of reasoning based upon patterns of distribution. It may be true that in paleontology one must assume that the present is the key to the past. But when one is dealing with patterns of geographical occurrence he never has all of the requisite facts of present-day ecology and genetics to make an adequate judgment of the factors involved in the past. Nevertheless, Goodspeed deduces that *Nicotiana* originated in South America in the early Tertiary, thence spreading to North America and across Antarctica to Australia, New Zealand, and the islands of the South Pacific. The bases for these deductions appear to be primarily the times at which the various land masses involved became joined or separated and the presumed length of time for a particular "quantity" of evolution to have taken place. The limits of error of these two criteria have scarcely been securely set. But then this is more or less standard operating procedure in taxonomic problems and has been for some time.

All but four of the sixty recognized species of *Nicotiana* have been grown in the greenhouse or field and have been available for experimental studies. Morphological and anatomical investigations have been carried out on all. Goodspeed limits his discussion to general morphology, anatomy, and trichomes (Part II), cytology of species (Part III), and cytology of F_1 interspecific hybrids (Part IV). *Nicotiana* is not characterized by any one specialized feature and there is marked variation between species in habit, inflorescence, and flower, all of which is well illustrated. As one would expect, the majority of anatomical distinctions are quantitative and thus of less use at the level of species. Goodspeed attaches especial importance to the trichomes which are believed to follow patterns paralleling those developed from studies of general morphology, geographical distribution, and cytogenetics.

An especially interesting part of the book for me is the section on the cytology of species and the cytology of F_1 interspecific hybrids. The details of chromosome morphology and behavior for fifty-six species and their hybrids are described in five chapters. Apparently there is no species known to be an obligate apomict, but some may be facultatively apomictic upon occasion. Chromosome morphology is quite homogeneous. Aneuploidy appears to be rare, but amphiploidy is of frequent occurrence and is thought to be a basic factor in the earliest evolution of the genus. Karyotypes and complete meiotic sequences in representative species and hybrids are illustrated. In the interests of establishing chromosome homology, which is expressed in the amount and type of pairing in F_1 hybrids, Goodspeed makes an analysis of 215 cases. He finds that they may be grouped into five categories ranging from complete pairing to almost no pairing. It is obvious that the analysis of chromosome nature and behavior forms a major source of criteria for the segregation and alignment of groups of species and sections.

Part V, entitled "Phylesis," consists of two chapters. The first paints in very broad and general terms the author's views concerning the origin, relationships, and evolution in the genus. The second discusses the possible "future" of the genus and is based upon what is deduced about the present and the past. Here, as elsewhere in the book, little information is given about the genetics of species populations. One does not gain any concept of population structure or, indeed, of the genetic systems at work at the level of species and below. This is a very noticeable and, I would think, serious gap in the presentation and in the data. Goodspeed envisions the present-day species to have arisen from a complex comprising pre-Nicotiana, pre-Cestrum, and pre-Petunia elements. Evolution of these hypothetical forms presumably gave rise to the modern genus with its cestroid and petunioid complexes. *Nicotiana* can be considered the residue of a polyploid complex based on the chromosome number $n=6$. Forms with this number are no longer extant, however, and the existing species may be arranged on two levels of polyploidy with about one-third of these at the higher level. These conclusions are diagrammed in an interesting representation of the levels of advancement and the degree of relationship of the various taxa. Goodspeed believes that in the future: " . . . the genus may be expected to expand both genetically and geographically, with greatest increase in number of species on the higher polyploid level."

The concluding section of the work, written with the collaboration of Helen-Mar Wheeler and Paul C. Hutchison, is the section on formal taxonomy and nomenclature. Its 170 pages contain the usual historical resumé, generic and specific descriptions, keys to taxa, and lists of cited specimens. Here the relatively minor attention devoted to lower categories is emphasized by the use of variety as the only category below the rank of species and, while these are keyed out, they are not discussed in detail. One cannot be sure whether the authors really mean these forms to be considered taxa below the level of subspecies (as the International Rules of Botanical Nomenclature would indicate) or if they consider the term variety to be equivalent to subspecies or to be the only infraspecific category.

The reader will almost certainly be drawn to make a comparison between "The genus *Nicotiana*" and other general works on genera of plants and animals which have appeared in the last few years. I feel that it is not only difficult, but somewhat unfair, to make such comparisons. Investigators have naturally emphasized those features of the groups upon which they have worked which are the most amenable to study and which thus make a significant quantitative as well as qualitative contribution. For *Nicotiana* it would seem that the greatest contributions lie in the fields of morphology and cytogenetics. For this reason Goodspeed's book will be an indispensable reference work for the biologist interested in evolutionary problems.—Richard W. Holm, Department of Biological Sciences, Stanford University.